VOL. 37, NO. 9 SEPTEMBER, 1960

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Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION, 1508 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

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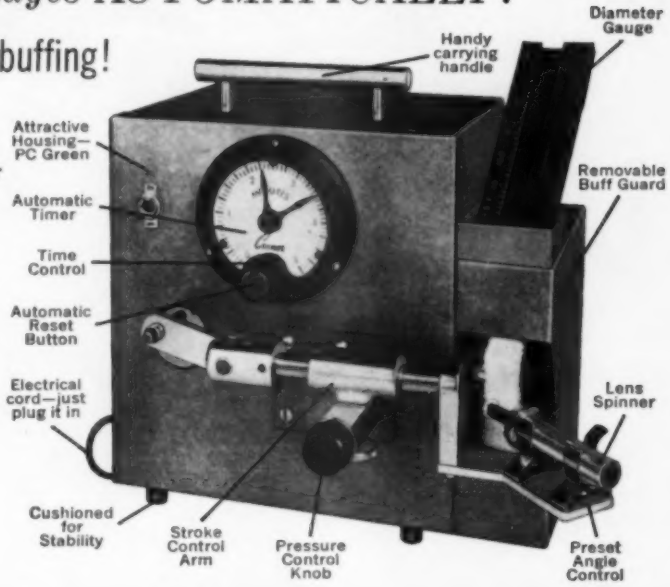

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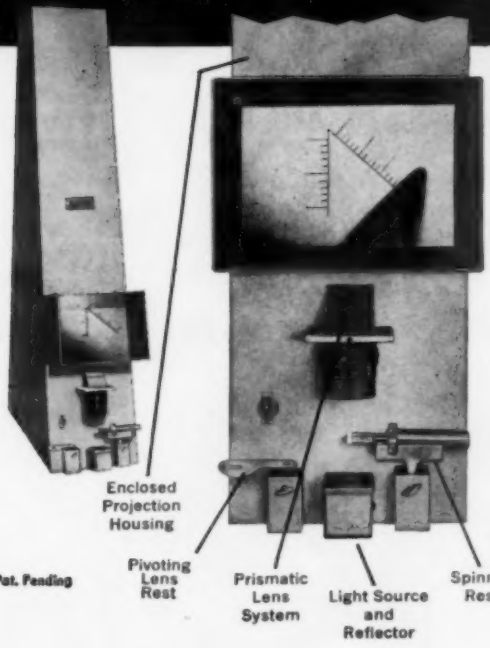

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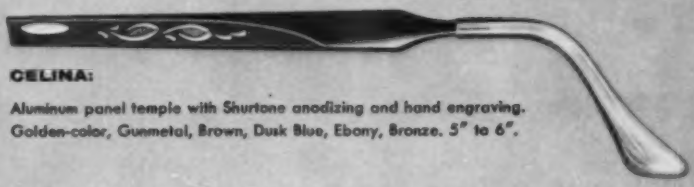

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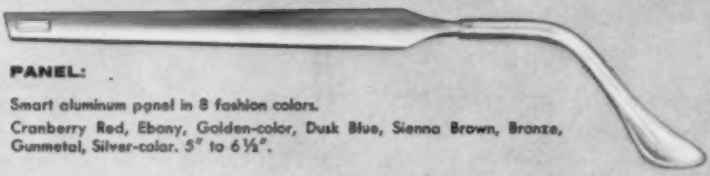

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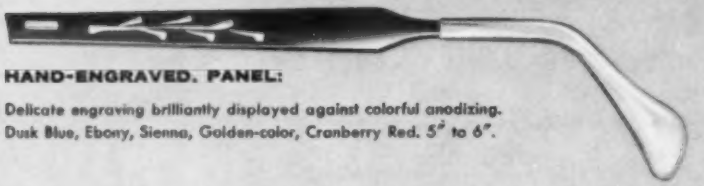

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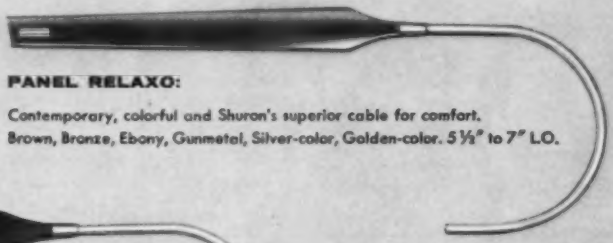

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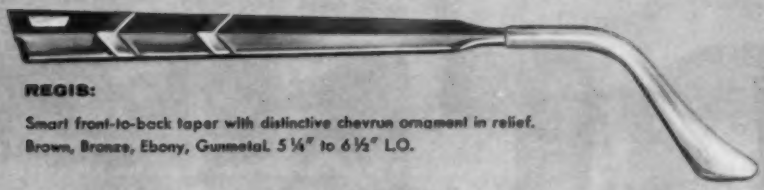

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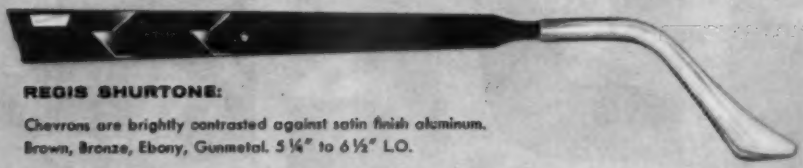

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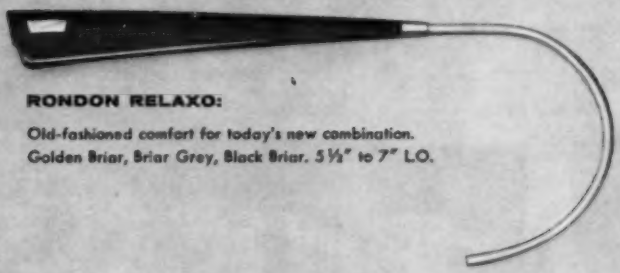

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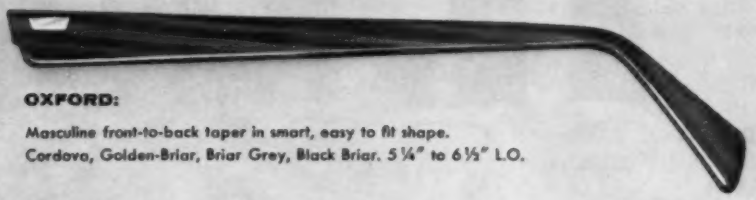

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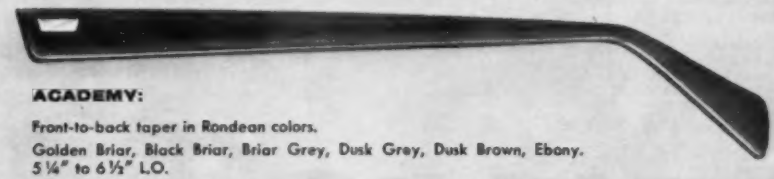

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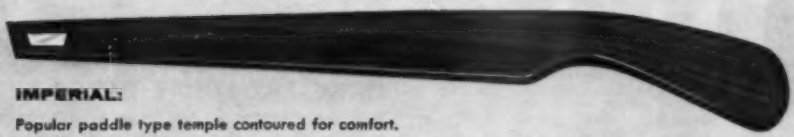

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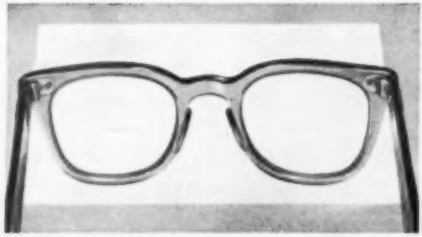

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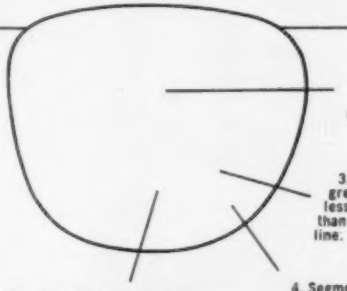

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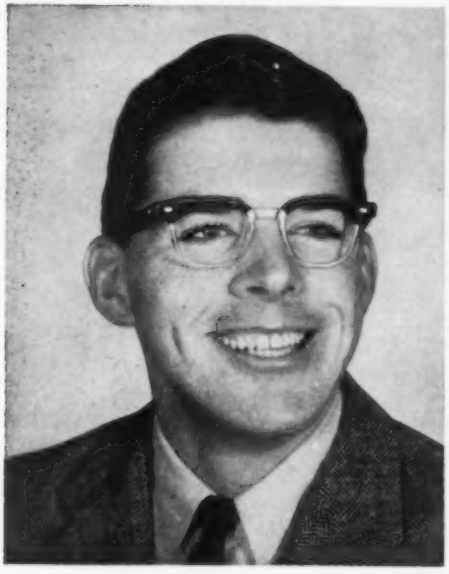

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AMERICAN JOURNAL OF OPTOMETRY
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Vol. 37 September, 1960 No. 9

THE TEAM APPROACH TO DIAGNOSIS OF REMEDIAL READERS*

Clifford J. Kolson†
University of Oregon
Portland, Oregon

PRELIMINARY STATEMENT

Every child entering school is expected to learn to read. Most of them, contrary to what critics say, do. Although the normal child who does learn to read is important, this is not the theme of this paper. Researchers, educators and teacher training institutions have accumulated masses of information an how to handle the normal child who learns to read easily. I am interested in the child who has difficulty learning to read, or who never does learn to read.

Some children cannot read, or have difficulty learning to read, but their reading disability is the only serious anomaly they display. There are no emotional factors or visual factors, or environmental factors present which contribute to the disability. These children can be taught to read by an adjustment of the methods and materials within the classroom. These are the corrective readers who with modern methods and materials combined with better trained teachers are being taught to read efficiently in the classroom.

I am concerned with the remedial reader, the child with a serious disability. These are the children whose parents cry on our shoulder. Many theories have been advanced concerning these children. Flesch[1] believes poor teaching to be the cause even though he makes no effort to explain why some learn and some do not. Gillingham[2] states that it is all a matter of dominance and immediately we divide into opposing camps. Smith[3] theorizes "synaptic" connections and the drug stores do a land office business. Delacato[4] promulgates a theory which would have the parents postulating their children during sleep. This would lead to no remedial readers and according to Kolson would lead to a nation of bleary eyed parents.

RESEARCH GIVES FEW ANSWERS

Almost all theorists lay claim to research as a base for their theories. About the only thing that can be said for research in reading is *that regardless of the position you take you can find a study to back you up.*

*Submitted on May 24, 1960, for publication in the September, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Reading Specialist. Assistant Professor of Education.

Many questions arise when we consider the results of research. One of the most efficient and capable teachers I have ever known did the research for his doctorate with tachistiscopic training as the only variable between a control group and an experimental group. His results show an insignificant gain with the use of the tachistiscope. Yet to this day when he teaches adults he uses tachiscopic training as an integral part of his program. Perhaps it is a tribute to his genius, or perhaps, he, like Julian Huxley,[5] believes most of the research in the social sciences, of which education is a part, is purely pseudo research.

Possibly a new approach to remedial readers is needed. This becomes evident if we consider Gray's[6] surveys of research studies in the encyclopedia of Educational Research. In all areas of reading, such as method, diagnosis, vision, or mechanical devices, the word "inconclusive" is always present. The reasons Gray gives for this inconclusiveness are: (a) the experiments lacked sufficient breadth, (b) adequate controls, (c) the design could be questioned, and (d) unwarranted conclusions were drawn. It seems to me that if we were to ask researchers in education to study the relationships of Mark Anthony and Cleopatra they would probably concentrate on Anthony's age, which was in the late thirties, and then announce to the world that the freezing point of love is not 32.

It seems to me that this confusion will not end until there is greater cooperation among the specialists involved. This paper is not an answer but merely a point of departure towards greater cooperation.

A University Reading Clinic, with which I am familiar, has been in operation for approximately thirty years. During this time thousands of children have gone through the process of diagnosis and remediation. Several years ago some of us decided these files were a treasure chest of information concerning remedial readers. We went through these files looking for the following things: 1. What is the average remedial reader like? 2. What are the causes of the disability? 3. What were the conditions present at the time of diagnosis?

As to the first, our conclusions were that the average remedial reader: is a boy aged 10½, who is in the fifth grade; reads at the first grade level, and has repeated a grade; has an average I.Q.; thinks he is dumb. The causes of his disability ran from infrequent attendance to aphasia and were too numerous to discuss here. Generally beside the existence of the academic disability, other anomalies were present. Emotional factors were present in a majority of the cases. Visual disabilities were present in some of the cases. Others had endocrine disorders. A few had auditory difficulties.

Possibly the safest conclusion concerning this study is that the

child who is referred to a remedial or diagnostic clinic is a complex problem, exhibiting many anomalies. Therefore, in order to make an adequate diagnosis many areas not directly within the competencies of the remedial reading teacher must be explored. Certainly the remedial reading teacher is not an expert on vision, yet since vision may be a contributing cause, a thorough examination is necessary. Nor is she an audiologist, yet since hearing may be a contributing cause, a thorough examination of the child's hearing is necessary. Although remedial reading teachers take many courses in psychology they are not psychologists and therefore they are not competent to perform the psychological evaluation of a child's behavior. Yet, if the therapeutic diagnosis is to have any value the investigation of the child must include these areas.

In recognition of the remedial teacher's limitations, many writers attempt to give the teacher lists of symptoms and their possible causes. *This generally creates as many problems as it solves.* Take the ordinary headache which occurs after the child has read a while, it is quite possible that some visual anomaly is causing the headache. Yet, clinical practice has shown it could very well be caused by an endocrine disorder. Or perhaps both are involved: recently Reynolds[7] reported the presence of fluctuation in the visual efficiency of a diabetic patient. Since Psychologists report that many times children set up physical symptoms in order to avoid an unpleasant task, the headache could very well be psychological. As we can see, although the symptom "headache" gives the teacher some indication as to what may be the cause, *she still does not know what is the cause, or what its relationship to the child's reading difficulty is.* To know the cause and its relationship to the reading problem calls for competencies the teacher does not possess. In fact it calls for knowledge which it is virtually impossible for any one person other than perhaps an Aristotle or a Francis Bacon to acquire.

Let us take a look at the task which confronts the remedial reading teacher, if she hopes to keep up with research in reading. Gray[6] reports in the Enclyclopedia of Educational Research that in the seven year period, 1951 to 1957, over 700 scientific studies related to reading were published in the United States and England. Generally an abstract consists of 600 words. If we do a little multiplication and then try to estimate the time spent in reading the abstract, locating pertinent studies, reading and analyzing the studies, we can get some idea of the tremendous task facing the remedial reading teacher who hopes to keep abreast of the research in her field. If she attempts to keep abreast of the research in the related fields, such as vision, audiology, medicine and psychology, *she can only become a candidate for a nervous collapse.*

Add to this the fact that many studies seemingly having no relationship to a field sometimes have implications for the field. Recently a psychologist investigating subliminal learning divided a group of rats from the same litter into a control and an experimental group. The control group was raised in a room having bare walls. The experimental group was raised in a room in which the walls had been covered with wallpaper containing geometric figures. When the rats were grown, an attempt was made to teach them to differentiate between geometric designs. The rats raised in the wall-papered room learned significantly faster than the control group. This has placed an impediment in the way of those who insist on reinforcement as a necessity in learning since no attempt to motivate either group of rats occurred.[8] It also indicates a certain amount of subliminal learning which substantiates the results of Burt[9] who got the same results by reading Greek to his two-year old child. Yet, this experiment had certain visual implications. One of the important cogs in this experiment was the constant bombardment of the visual stimulus of the wallpaper. Yet what percentage of optometrists are familiar with the study? Probably few, since in no guide to research is it listed under vision. This study does substantiate my contention that many times implications are in seemingly unrelated research, and to locate this kind requires wading through a tremendous amount of irrelevant material.

This impossibility of becoming an expert in all the fields related to remedial readers manifests itself in a way which is at times even dangerous. This is in the conclusions drawn from research based on wrong assumptions. Again and again Gray[6] in the *Enclyclopedia of Educational Research* points out that the conclusions drawn by some researchers in vision and reading are based on a limited definition of vision. A perfect example of this is a study made by the health department of one state which claims the Snellen chart is still the best visual screening device for school children. Their results were based on a comparison of the results of a Snellen with the results of one other vision test; yet, Snellen is the best of all tests.

So far we have attempted to show that reading problems are complex problems requiring experts from many fields in order to make an adequate diagnosis. It is almost impossible for any one person to become an expert in all these divergent fields. Therefore, in order to make an adequate diagnosis either (1) we must more and more employ the team concept in diagnosis, or (2) we must have better communication between the specialists in the various fields related to reading.

The better answer seems to be in the team approach to diagnosis.

A number of years ago a local optometrist in the town where I was principal, and I, decided to attempt to cooperatively work toward diagnosing children with reading disability. Later we added a psychologist, and also utilized the services of a physician. This clinic grew much like Topsy. In the beginning there was one thing each of us was definite about. Each knew *exactly* what was the cause of reading disability. The optometrist was certain all cases of reading disability had a visual basis. The psychologist felt emotional factors were at the root of all disabilities. Whereas, the physician's prescription was "Phonics, phonics and more phonics." Me? I was the only one who was utterly confused and knew it.

A funny thing happened—unlearning must have taken place because after years of working together we all lost our definitiveness concerning THE cause of reading disability. The optometrist no longer considered vision as the primary cause of all reading disability. The psychologist began to admit that although most children with disability displayed emotional factors, only in a small percentage were the emotional factors the cause of the disability. What I am saying in reality is that each of us grew in our understanding of the relationships between the various areas of specialty involved in the diagnosis of the child.

This team approach to diagnosis not only led to a more adequate diagnosis but also contributed to the professional growth of each member of the team. Let me illustrate this through two events connected with this clinic. One day the physician told us of a report which had appeared in a medical journal of an experiment in which glutomic acid had been used to raise the I.Q. of children. Glutomic acid is used with epileptic patients to change the structure of the blood vessels thereby allowing more oxygen to reach the brain, thereby improving the function of the brain. We began to speculate concerning the possibility of glutomic acid as a stimulant to increase the reading ability of some poor readers. The design of our experiment followed these lines. I devised three stories in Constructed Alph. equated as to length of time it took our wives to learn to read them. Then the optometrist, the psychologist and the physician were taught by me, using beginning reading methods, to read the first one and the learning time was noted. Then five acidulin capsules were taken by each of the subjects each day for seven days. After which they were taught by the same procedures the second story and th learning time was noted. Another week of capsules and then the third story. The results showed an overall improvement in the rate of learning by the group of 28%. Now inexperience in research procedures caused us to commit several errors which made the results of the experiment inconclusive; but the point is—*the team approach to reading had*

led to experimentation with drugs in reading years before the current fad which seems to be gaining momentum.

Not only in experimentation but in the area of remediation, too, we were trying unusual methods. A young boy was referred to the clinic and my tests showed him to be very weak in vocabulary, comprehension and word attack skills. Although he was in the fifth grade his reading ability according to the tests administered was 1.2. Although the boy wore spectacles the optometrist found nothing in the area of vision which might be a contributing cause to his disability. A similar report was made by the physician. The psychologist found him to have an above average I.Q. During the staffing session I held out for a concentrated skill development program of remediation. The psychologist presented a different program based on his interviews with the parents. When the decision was made it seemed that the optometrist and the physician agreed with the psychologist. We told the parents we would work with the boy for three weeks then we wanted her to enroll him in the summer program offered at a local academy. At the end of three weeks the boy went to the academy where tests revealed that using the psychologist's method, we had raised his reading level in three weeks from 1.2 to 5.7, a growth in three weeks of 4.5 years. On the basis of this one case my reputation in the town was made. My school promoted me—I was asked to write articles for the newspaper. Now comes the block buster. What was the method? *Why, the mother paid us $7 an hour to have me drink sodas with the boy.* Not once did we touch a book, try to learn a word, attack reading mechanics or skills, or anything considered remedial technique. Why the phenominal gain? The psychologist was convinced the boy knew how to read but refused to read. He felt that if I developed good rapport with the boy he might read because of his liking for me. Subsequent events proved the psychologist's theory correct, *and prevented me from spending a lot of time in an attempt which probably would have failed.*

I think these illustrations are sufficient to show the advantage of a team approach to diagnosis and remediation, with experimentation.

At the present time I am conducting a reading diagnostic clinic utilizing the team approach—Advanced graduate students from the fields of psychology, guidance, speech, social work, and remedial reading form a team for the diagnosis of children with extreme reading problems. On a consultant basis this team has the services of a physician, an optometrist, and a neurologist. Everyone concerned with this project is convinced the team approach has led to: 1. Clarification of the role of each area of specialization. 2. Elimination of much misinformation con-

cerning principles and concepts in areas outside the competencies of each participant. 3. Increasing knowledge of the terminology of the various fields. (Cycloplegic is a familiar term now to each participant.) 4. An understanding of the interrelationships of all areas in a case of reading disability.

Although these four things are of great importance the participants are unanimously agreed (*and this is important since getting a physician to admit he has learned something from someone not an M.D. is like getting an alcoholic to take the pledge*) that the most significant contribution of this team clinic is the dissemination of unsubstantiated by research clinical knowledge.

As far as I know there has been no research reported concerning age of parents as a contributory cause of reading disability. At one of our staffings a psychologist from an Adult Counseling Center reported that clinical practice had caused the staff to notice that many adults with problems had parents who were past 40 when the child was born or adopted. Clinical experience had led the guidance people to believe this led to problems because:

1. People past 40 did not have the energy for prolonged physical activity in which young children like to engage. 2. Although older people like children they tended to expect more mature actions from children than young adults do. 3. Older people seem unwilling to cuddle and hug young children for as long as young adults do.

Using this unsubstantiated clinical knowledge from a guidance center as a working hypothesis in several cases where we were making an etiological diagnosis, we arranged for several counseling sessions for the parents, and a series of meetings with a child psychologist for the child. The evidence gathered from these sessions led us to conclude that the age of the parents was a major contributing cause of disability in these cases. *Now the point I want to make here is this:* all clinicians develop certain principles, assumptions, and techniques which because of many reasons are never substantiated yet are invaluable in clinical practice. These working assumptions, techniques, and principles are seldom reported because they are not confirmed by research. Hence, regardless of the extent of the survey of literature one would make, he could never learn this working hypothesis in any other way than by direct contact. This seems to be one of the most invaluable contributions of the team approach.

Unfortunately, the time when we will see widespread use of the team approach is a long way off. At present the cost is prohibitive. If the men needed to make a team diagnosis were paid what their train-

ing and knowledge is worth, parents wanting a diagnosis of their child's disability would have to pay an amount which would limit this service to only the children of the very wealthy. Further, since teachers have consistently subsidized public education through low salaries, thus keeping educational costs lower than our national liquor bill, almost any charge for educational services seems to be too much. A Portland optometrist and a Portland reading specialist operate a Reading Improvement Center where they practice team diagnosis and remediation on a limited scale. People inquiring as to the services many times object to what they consider the tremendously high cost. A high cost which equates to about two-thirds the charges of a TV repairman. As long as this attitude prevails, team diagnosis will not be widespread.

Perhaps what we can realistically hope for is that some professional organization interested in reading will take the lead in establishing, at some university, a research clinic employing the team approach. Dissemination of the findings of this center could very well serve to improve knowledge in the places where team diagnosis is too costly.

There are a number of things we can do, however, to improve the communication between the reading specialist and the optometrist while we wait for the millenium.

To teachers I would suggest that I have found optometrists as a professional group to be more interested in reading than any other profession. And this is an active concern. The AMERICAN JOURNAL OF OPTOMETRY is the only national professional journal outside of the educational field which consistently runs articles dealing with educational matters. Teachers should take advantage of the optometrists' interest in education.

When a teacher arrives in a new area she should make every effort to cultivate the friendship of an optometrist. Once she has estabished rapport with him they will find that they can contribute *much* to each other's professional growth. They can exchange information concerning vision and reading which will give each a better understanding of the problems facing each specialist, thus, probably giving greater benefits for the clients of each. A by-product of this exchange of information is the diffusion of the knowledge acquired. In the teachers' lounge she relates visual information, and at lunch the optometrist relates things he has learned from the teacher.

A second thing that can be done to improve communication between our two fields is for the professional schools to design courses to fit the specific needs of people in related areas. As it stands now, reading teachers usually get information concerning vision and its relationship

to reading, from experts trained in the field of education, whose knowledge of vision came from experts trained in education, whose knowledge of vision, etc. What I am getting at is that many times this leads to perpetuation of misinformation. Novices in any field require simplicity and concreteness in the beginning stages of learning. This applies whether the learner is a first grader developing number concepts or a college student taking his first course in electronics, or a teacher studying vision as it is related to reading.

If anyone doubts what I say, I ask him to go to the library and read *Nucleonics*. He will never learn anything concerning nuclear physics if his reading of nucleonics continued for a hundred years. The reason for this is that the contributors to this magazine are writing for professionals in the field and therefore assume certain knowledge on the part of the reader. If we want to learn nuclear physics, we first must learn the basic concepts and terminology so that we can move to the more complex. In other words, *things must be simple*. Now anyone who has taught knows that the ability to make learning clear and simple correlates highly with the amount of knowledge the instructor possesses. It takes a tremendous amount of knowledge to make something clear and simple. Yet in schools of education we have people teaching vision as it relates to reading whose training in this area probably consists of one class period devoted to vision and reading, and the readings from a bibliography. By no stretch of the imagination do they possess the tremendous amount of knowledge to give their students anything but an encyclopedic overview of vision and reading. And my optometrist friends assure me that many times this is misinformation.

It seems to me that teacher institutions should offer short courses in vision and reading taught jointly by an optometrist with clinical experience in a reading clinic and a reading specialist who has a better than average grasp of knowledge of vision. This makes sense. There are two areas involved here, why not two instructors. At the present time such a course is in the planning stage at the Portland Extension Center and I am certain it will justify my belief that visual knowledge should be taught by a vision specialist and not by a reading specialist.

The third thing that can be done is to learn how to communicate with each other. The following letter was received by a teacher who had inquired of an ophthalmalogist concerning the possibility of a visual problem contributing to one of her charges' reading disability.

"In reply to your letter of April 11, I examined the above on January 15, 1959, at which time he was found to have an esophoria of eight diopters for near, and consequently his full cycloplegic refraction was prescribed. This correction is a moderate hyperopia astigmatism."

Probably this reply does not seem strange to the vision specialist,

but it means almost nothing to the average classroom teacher. Leaving out the names in the letter, I asked 213 students to, without doing any research, explain what this meant and what effect this would have on a child's ability to read. These teachers represented 23 states and 67 training institutions. The educational range was from a B.S. to predoctoral. These were the results:

1. Forty-one had a vague idea what esophoria was. 2. None knew what a cycloplegic refraction was. 3. Over 50% knew what hyperopia was and what astigmatism was but all were confused concerning the use of the two terms together. 4. None would venture a guess concerning the relationships of the conditions described in the letter to reading disability.

Now this is not meant as a criticism of the ophthalmologist, nor as a criticism of the teachers. Every field has its terminology. In education we call it pedagese; in optometry it probably would be called optimese. It consists of terms which are used so much that we tend to forget that people not in the field have no idea what concept lies behind a particular term. It is just as much a foreign language as Nepalese. The end result is, *we fail to communicate*. If we are to improve the communication between our two fields, we must *not* assume knowledge of the verbiage by the person to whom we try to communicate.

I feel that before I suggest the fourth thing to improve communication between optometrists and reading specialists, I must offer a rationalé, I am certain what I will say will irritate some. In education there is no such thing as a good method. A method which might be good with Joe may be absolutely valueless for Mary. A method can be judged good or bad only in relation to its success or failure when used by a particular teacher with a particular pupil under particular conditions.

This same type of thing exists in social settings. Every one of us knows a person with whom we just cannot get along even though others can. At the other extreme there are people whom no one likes but yet with whom we maintain good relations. Professionally this applies. There are some professional people with whom we can work better than we can with others. The major concern in any remedial reading case is the child. It is not the teacher or the visual expert. Hence, it is necessary for the good of the client that the eye man consulted by the client be one with whom the remedial teacher has good rapport. It is just as important for the remedial reading teacher to be allowed to decide who shall work with him on a particular case as it is for the physician to choose which specialist to call in for consultation and when physicians

have called in a specialist for consultation where I was the patient, they told me who it would be.

This right of choice of consultant is given to all professional people except the remedial reading teacher. Many times some optometrists object strenuously because I recommended a particular optometrist. My recommendation was not meant to mean that the other optometrists were incompetent, but only that the particular optometrist I had recommended and I had established the kinds of relationships which meant that his work would be more closely tied to what I wanted because we had learned to communicate with each other.

There is another factor which must be considered in this line. As a youth my father impressed upon me the fact that Christ had twelve disciples and one was bad; therefore, if approximately eight per cent of saints were bad it is reasonable to assume that we will have at least the same percentage of bad among ordinary folk. I would be the last to say that in teaching there are no bad teachers. Likewise there are in the profession of optometry some members who have not kept abreast of recent developments. Now it is very discouraging for a teacher to recommend that a child suspected of having visual difficulties go to an eye man and then to learn later that the eye man made no near point examination, or did not concern himself with how the eyes functioned in a reading situation. To ask the parent to repeat the examination would be questioning the professional ability of someone we, as teachers, are incompetent to judge; therefore, we must continue the diagnosis with one of the most vital areas unexplored. The fourth suggestion is that teachers be given the right to recommend a particular optometrist.

The fifth suggestion I would like to make is that associate memberships in each other's professional organization be extended. My own professional organization, the International Reading Association, has no bar against optometrists becoming members. By the way—this has always made it easy for me to locate an optometrist who had an interest in reading. Perhaps this is why optometrists are better informed, as a whole, concerning reading than reading teachers are informed concerning vision. Without some type of membership in optometric associations, reading people are prevented somewhat in access to research and studies in the field of vision done by people acceptable to the optometrists.

Let me illustrate this. I suspect Robinson's[10] *Clinic Studies in Reading* to be the best liked material on reading and vision among optometrists. Much of the research reported there and in other articles was done by Robinson and Huelsman[11] of Miami University. In 1958,

Huelsman read a paper at a meeting of optometrists in Cleveland, Ohio. The paper was later published in the AMERICAN JOURNAL OF OPTOMETRY. The paper was a case study summary of all research in vision and reading up to and including 1957. This valuable summary of research to this day remains unknown to many, many teachers because of where the paper was read and where it was published. If teachers had some type of associate membership in optometric organizations they would have had the benefits of this brilliant paper.

My sixth suggestion is a plea for assistance in a vital area. My wife is a victim of the broad interpretation by the State of Oregon, of the term nepotism, hence she is teaching remedial reading in the public schools. Both she and I taught for several years at Miami University where we knew Dr. Huelsman, hence, she is very conscious of vision as a contributory cause of reading retardation. Three weeks ago she received a student from another school. She worked with him two days and noticed that he had a peculiar habit of shading his one eye when he read. Now this is a symptom neither she nor I had ever encountered before. After discussing it with me she looked into the child's health record. Sure enough each year's visual screening gave him 20/20 vision. Nevertheless she asked the parents to have his eyes examind by an optometrist. The child definitely had a visual problem. The parents were perplexed since each year the school visual screening had uncovered no eye difficulty.

This is one case, but it is a case which can be multiplied many times. Vetterli[12] called the continued use of the Snellen chart as a school screening device the perpetuation of a myth.

> "If vision specialists recognize that the screening devices commonly employed by schools are not only inadequate but also may do much harm by delaying the correction of visual defects, why does this practice continue? The most obvious answer is that the Snellen chart is still the quickest and easiest way to screen large numbers of children. Of course, this is not a good answer. There can be no substitute for an annual examination in the office of a qualified vision expert, throughout the period of a child's school attendance. That ideal will not be attained or even approached so long as parents, teachers, and school authorities believe in the myth of 20/20 vision. And each time the Snellen chart is used for screening that myth is perpetuated."

It is perpetuation by our sin of omission. Its death knell will not be sounded until optometrists and educators cooperatively and vigorously attack it with every means available. Many years have passed since Snellen invented his chart. With all the water which has run under the bridge since then, it is hard for me to believe that optometry has made so little progress that it has not been able to devise a more adequate screening device for the schools. If optometrists have devised a better screening device, and I know they have, then they must accept the blame for not having gotten this message across to the people, since the Snellen

chart is still the most used screening device in our public schools.

Some optometrists say this is the educator's problem and not the problem of the optometrist. It is hard for me to believe that the optometrist's duty to the vision of children should be confined to only those who seek him out, for as Vetterli points out, many times this delays the treatment. I believe visual education of the citizenry to be just as vital a part. Therefore, I would like to see the optometrist join with the educator in working to have a better screening device introduced in the public schools. This is one area where the educator is stymied. A school board member or a state department official with limited concepts of vision can ask the teacher what she knows about visual screening and the answer of the teacher must be, little. But optometrists could say the Snellen chart is inadequate and because of their training no one could argue the point. I believe this is one area where cooperative effort between the optometrist and the teacher is vitally needed.

My seventh suggestion is for educators and optometrists to work together to plan and carry out research in the field of vision and reading. Gray has stated again and again in his summaries of research in vision and reading that the concept of vision in so much of this type of research was too limited. This need is too obvious to require further discussion.

I hope that I have been able to show that remedial readers have complex problems requiring the services of many specialists if adequate diagnosis and subsequent *successful* remediation is to be achieved. Until clinics which employ the team approach to diagnosis and remediation are established we must work for better communication between our two professions. This can probably be done by: 1. Establishing interprofessional rapport. 2. Designing related courses taught by qualified instructors. 3. Reducing the necessary technical terminology in interprofessional correspondence to language understandable to the reader. 4. Permitting choice of consultant to the optometrist and the remedial teacher. 5. Allowing associate memberships in each others professional organizations. 6. Cooperating in eliminating the Snellen Chart as the major screening device of the public schools. 7. Executing cooperative research in vision and reading.

I would like to close with a plea for us to approach our common problems with a healthy attitude. We must not allow the thought of cooperation to frustrate us. We must not end up like the monkey I saw coming out of the library the other day with the Bible under one arm and Darwin's Evolution of the Species under his other arm, shaking his head with a perplexed look on his face and mumbling, "It can't be

true that I am my keeper's brother."

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TWO STEREOSCOPIC MEASURES OF CYCLOROTATION OF THE EYES*

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INTRODUCTION

The existence of cyclotorsional rotations of the eyes, i.e., wheel-like turning about the visual axes, has come to be accepted generally as one of the normal eye movements.[1] The history of the controversy leading to this acceptance is reviewed by Allen,[2] Hermans,[3] and Ogle and Ellerbrock.[4] This controversy centered about the laws of Listing and Donders and the techniques of measurement by which these laws were demonstrated.

Historically, measuring devices for assessing cyclotorsion have depended upon the binocular alignment of monocular test elements. The test stimuli generally consisted of fusible binocular material, usually a central disc or ring, and monocular radii to be aligned in binocular vision as a diameter or diameters. Such test stimuli have come to be known as "Volkmann's discs."[2, 3] Recently, Ogle and Ellerbrock[4, 1, 5] have employed stereoscopic equidistance as a measure of cyclotorsion. The test stimuli for this measurement consisted of vertically displaced points of light to be adjusted to equidistance or verticality in stereoscopic vision. The customary level of precision with both the stereoscopic and the interocular alignment measure has been one-tenth of a degree.

In the present work, in an effort to increase the sensitivity of the stereoscopic measure of cyclotorsion, a peripheral circle was added to the vertically displaced dots employed by Ogle and Ellerbrock. This modification of the test configuration provided the possibility of setting the dots to equidistance with the circle as an additional stereoscopic measure of cyclorotation of the eyes. The basic dot configuration and two forms of the added peripheral circle are illustrated in Figure 1.

THEORETICAL

The apparent modification of these configurations in the presence of cyclorotation of the eyes, both the dots alone and the dots with the

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*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 12, 1959. For publication in the September, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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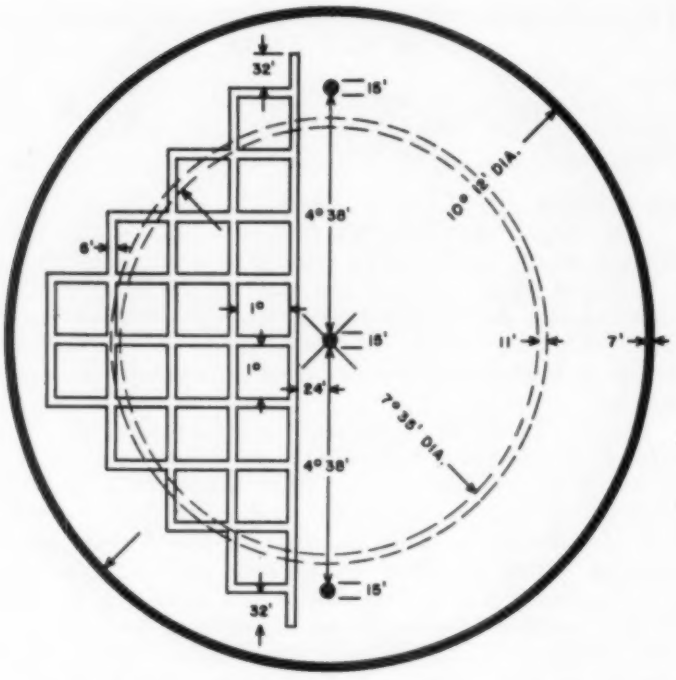

Fig. 1: Angular subtense of the various elements of the stimulus configurations.

peripheral circle, is most adequately explained in terms of the correspondence of the retinas of the two eyes. Excyclorotation of the eyes, i.e., the tops of the vertical meridians temporally, will result in the displaced dots stimulating non-corresponding points with the upper dot appearing displaced in depth toward the observer and the lower dot appearing displaced in depth away from the observer.[1, 6] Encyclorotation of the eyes, i.e., the tops of the vertical meridians nasally, will result in the reverse. Similarly, rotation of the displaced dots about the center dot with the eyes fixed would result in stimulation of non-corresponding points of the two retinas and the apparent inclination in depth of the three dots.

The addition of the circle to the configuration does not alter the action of the dots. The circle is symmetrical about its center and, independent of the cyclorotational position of the two eyes, will stimulate corresponding points to appear in the plane of the vertical and horizontal

stereoscopic horopter. Stated another way, the circle provides stimulation for lateral and vertical fusion, but not for cyclotorsional fusion. This is true only to the extent that each point of the circle may substitute for every other point of the circle when rotated. The presence of nonuniform illumination and breaks in the contour of the circle will either inhibit the cyclorotation of the eyes or result in a stereoscopic displacement in depth of portions of the circle.

EVALUATION

Measurement of the cyclorotation of the eyes by adjusting the dots to equidistance, one with the other, or by adjusting the dots to equidistance with the circle, i.e., into the plane of the circle should be equally satisfactory. Both measures are readily available if provision is made for opposed rotation of the displaced dots about the central dot in the presentation to each eye. The disparity between the upper and lower dots consequent to the cyclorotation of the eyes can then be negated by appropriate rotation of the dots in the individual eye displays. Consistent with the rationale of corresponding points, such manipulation of the dots can be accomplished by the observer executing the appropriate equidistance task.[1] However, if factors other than retinal correspondence are effective in determining the subjective vertical in depth, the possibility exists that the two tasks may differ not only in the variability but also in the mean of the measures obtained.

The present work was initiated to demonstrate the equivalence of these two measuring tasks under conditions of minimal retinal stimulation.

EXPERIMENTAL

APPARATUS

The apparatus in which these configurations were utilized consisted

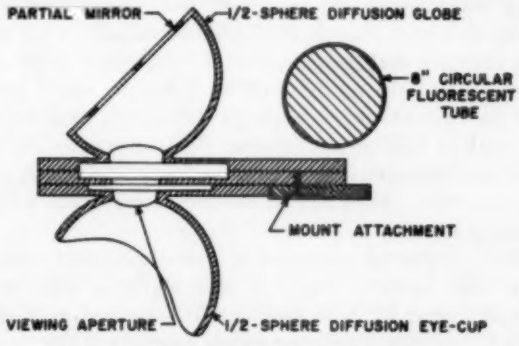

Fig. 2: Details of specialized eyepieces.

of three parts: A physical display; a stereoscopic display; and an observer position. The observer position was constructed to provide, in addition to the usual chin rest, diffuse illumination over the entire field of view. The object of this feature of the observer position was to permit control of the dark adaptation of the observer. This was accomplished by specialized eyepieces made of milk lucite in conjunction with a circular fluorescent tube as illustrated in Figure 2. The visual impression for the observer with the fluorescent tube lighted was that of looking into a fog of greater density at the periphery than at the center with an indistinct oval demarcation between the two zones. This oval demarcation enclosed a central field of approximately 15 degrees. It was formed by the temporal edges of the eyecup apertures which, since they were close to the eyes, could be seen only indistinctly.

The stereoscopic display was used to present the dots and, when required, a projected circle illustrated by the dotted circle of Figure 1. This was accomplished with a pair of reflex sights mounted to permit control of both the convergence angle between the optical axes of the reflex sights and the rotational position of the dots or dots and circle in the reticle holders.[7] The central dot and the center of the optical circle were brought by rotation to coincide (± 20 seconds of arc) with the optical axis of each sight. In stereoscopic vision, this resulted in the central dot remaining fixed while the displaced dots moved oppositely in depth, the upper dot away and the lower dot toward, or vice versa, without apparent movement of the circle. Adjustment of the convergence angle between the optical axes of the reflex sights was necessary to match their convergence to that of the observer in viewing the physical display. The optical system of the sights was focused to present the dots and the optical circle as if they were located at infinity.

Angular measures of the rotational displacement of the dots in their reticle holders were read to 0.57 minutes of arc. This was accomplished by a sensitive dial gauge activated by a short lever arm which extended from one of the reticle holders. Since the reticle holders were manipulated in opposition by a single drive, this was equivalent to reading the angle of declination between the two eyes to 1.1 minutes of arc. The various assemblies were ball bearing mounted to provide for mechanical sensitivity. Backlash in the measuring train was taken up by a light spring loading.

The physical display presented a transilluminated circle as illustrated by the filled circle of Figure 1, and a grid as illustrated by the unfilled lines of Figure 1. The display was generated on a single sheet of milk lucite by opaquing the appropriate portions of the front surface.

The grid or the circle could be presented separately or together through the use of individual light sources. The physical display was 250 cm. from the observer with the center of the display at eye level.

All displays and the light adaptation eyepieces were transilluminated by cool, white fluorescent tubes. The tubes were wired for instant starting and were under electronic timer control. They were adjusted to equate apparent intensities utilizing a circuit devised by Campbell, Shultz, and Abbott.[8]

OBSERVERS AND TASKS

Six observers were used. Their individual refractions are given as part of the data in Figure 3. Spherical equivalents were used in the instrument for all observers. Only Observers III, IV, and VI habitually wore spectacles. Since the observers were selected to sample a range of

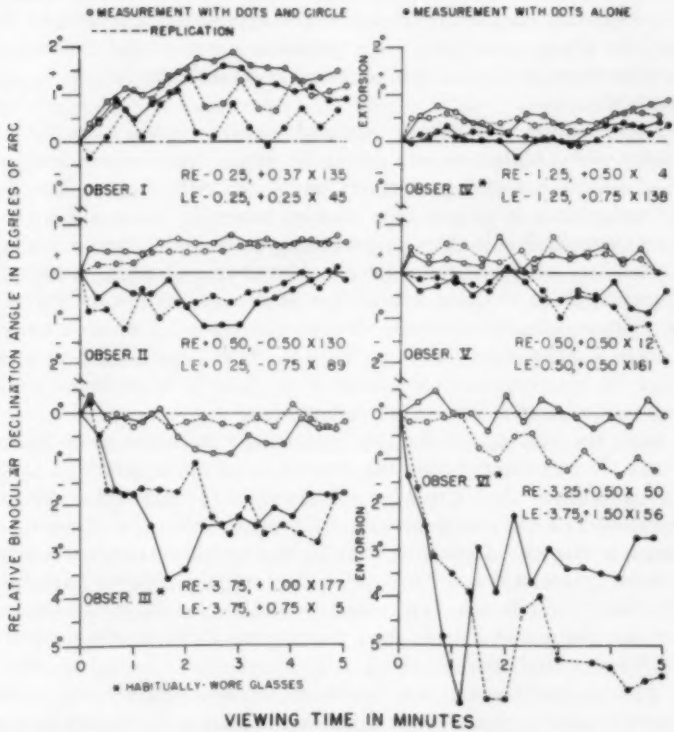
• MEASUREMENT WITH DOTS AND CIRCLE
------ REPLICATION
• MEASUREMENT WITH DOTS ALONE
RELATIVE BINOCULAR DECLINATION ANGLE IN DEGREES OF ARC
ENTORSION
OBSER. I
RE - 0.25, +0.37 X 135
LE - 0.25, +0.25 X 45
OBSER. II
RE +0.50, -0.50 X 130
LE +0.25, -0.75 X 89
OBSER. III *
RE - 3.75, +1.00 X 177
LE - 3.75, +0.75 X 5
OBSER. IV *
RE - 1.25, +0.50 X 4
LE - 1.25, +0.75 X 138
OBSER. V
RE - 0.50, +0.50 X 12
LE - 0.50, +0.50 X 161
OBSER. VI *
RE - 3.25 +0.50 X 50
LE - 3.75, +1.50 X 156
* HABITUALLY WORE GLASSES
VIEWING TIME IN MINUTES

Fig. 3: Cyclotorsion measures for selected astigmatic error orientations obtained alternately with the two observer tasks utilizing a physical circle.

orientation and magnitude of astigmatic error, no astigmatic correction was applied.

The observer's task involved the simultaneous manipulation in depth of the vertically displaced dots, the upper away or toward, the lower toward or away. This was accomplished by the adjustment of a knob available to the observer. The task was executed in the presence and absence of the circle. When the circle was present, the displaced dots were adjusted to bring them in to the plane or parallel to the plane of the circle. In the absence of the circle, the displaced dots were adjusted to equidistance, the upper with the lower, or until an imaginary line connecting the upper and lower dot was seen to be perpendicular to the line of sight.

The center dot, since it was at the optical center of the presentation, was seen as fixed in depth for all manipulations of the displaced dots. It served to indicate the depth position of the stereoscopic display and was used by the observer to "range" the stereoscopic portions of the measuring configuration to the distance of the physical display.

PROCEDURE

To investigate the equivalence and relative efficiency of the two measuring tasks, both were utilized to determine the presence and time order of appearance of the observers' myologic cyclophoria. The myologic cyclophoria is unique to a demonstration of the equivalence of these measures in that it offers various amounts of cyclorotation both for the individual observer and between observers and does not require the presence of stimulation other than that necessary to the measurement. Thus, differences between the two measures, if they occur, can arise from a minimum of sources, such as some feature inherent to the observer or his refraction, the manner of taking the measure, or the stimulation utilized in taking the measures.

Since the critical feature of the measuring stimulation under evaluation was the peripheral circle, the two types of circles available in the display were used. This provided a control for the visual characteristics of the circle as a possible source of difference, in that the physical and stereoscopic displays differed in their light distribution, contour irregularities, etc., since each was developed independently. More significantly, the physical circle was a fixed, unitary display in the binocular field. When this display was used, the only moving element was the stereoscopically presented dots.

The projected circle was presented stereoscopically. It required two sources of stimulation, one for each eye, and was oriented in space by the coordination of the optical systems and the fusional processes

of the observer. Significantly, the projected circle rotated with the stereoscopically presented dots. Thus, stereoscopic displacement which might have occurred with the physical circle consequent to cyclorotation of the observer's eyes would not occur with the stereoscopically presented circle, and, conversely, a constant displacement of the stereoscopic circle with respect to the dots due to asymmetries of the optics or errors in the stereoscopic presentation would not occur with the physical circle.

To limit the binocular stimulation available to the measuring configuration presented in the apparatus, a light adaptation interval was inserted between the taking of successive measurements. This was done to assure the appearance of the observer's cyclophoria and to eliminate extraneous visual stimulation which might either produce a difference or prevent the occurrence of a difference between the measures taken.

An alternation procedure was established between the light adaptation interval and the two measuring tasks. This was done to take advantage of the known dependence of muscle balance upon preceding viewing conditions[2, 5] to assure the equivalence of the cyclotorsion measured. To space the measures in time and control the light adaptation of the observer, the measuring configurations were alternated with the light adaptation field. The timing of these alternations was four seconds of light adaptation followed by a six second dark interval during which the measuring configuration was present as the only visible stimulation. The six second exposure of the measuring configuration provided sufficient time for an adjustment of the dots to vertical or into the plane of the circle to obtain a measurement of the state of the torsional muscle balance. The independence of these successive measures was assured by the experimenter's disturbing the adjustment of the dots in the light adaptation interval between measures. The observer was permitted to bracket in making his adjustments. No specific instructions were given regarding the final approach in making a setting.

Since the details of the apparatus would not permit alternation of the projected circle and the dots with the dots alone as just described, sequences were run successively when the projected circle was used, one with and one without the circle present. The order of with and without was reversed for the two observers so measured.

Five minute and twenty minute sequences of measures were taken to sample systematic changes and to assess the possibility that the relation of the two measures, one to the other, might differ with time. As in the case of the sequences taken with the projected circle, only two of the twenty minute sequences were taken.

Another facet of time in the interrelation of the measures is their day to day repeatability. Consistency among the observers in this regard would imply a dimension of individual difference rather than a momentary state of muscle tonus. This was sampled in the replication of the sequences of measurements in an interval of one to three days. In the case of the two observers (II and V) who served in the additional sequences with the projected circle and the twenty minute time interval, the taking of the measures extended over two weeks.

One element in the observer's refraction is of significance beyond its influence upon his potential ability to resolve the stimulus presentation. An astigmatic error may give rise to meridional magnification in the retinal image of the circle and result stereoscopically in its perceptual inclination to the subjective vertical. This factor could not be corrected by the use of ophthalmic lenses in the apparatus, since the expected cyclorotation of the eyes would negate the axis of application of the correction. Therefore, observers were selected to sample two groups of refractions: those in which the axes of astigmatism were inclined nasally, and those in which the axes of astigmatism were inclined temporally. Thus, if astigmatism were a factor in the measures, the resultant difference would be opposite in sign for these two groups.

The reference condition against which the measures of myologic cyclophoria were evaluated was generated with the transilluminated grid. The grid provided the necessary stimulation to cause the eyes to orient approximately as they would in viewing the normal environment. It was used to zero the rotation of the individual eye presentations and to make the convergence adjustment of the stereoscopically presented dots. To make these adjustments, the observer "ranged" the center dot to the depth of the physical display and simultaneously adjusted the upper and lower dots to equidistance with the vertical edge of the grid. The congruence of the equidistance adjustment of the upper and lower dots with the ranging adjustment of the center dot to the grid was taken as the zero reading to which subsequent measures were referred.

The adaptation illumination provided by the observer position was approximately 135 Ft. L. and that of the stimulation approximately 80 Ft. L. (The illumination measures were taken with a photoelectric brightness meter corrected to the sensitivity of the human eye.)

RESULTS

The sets of measures of myologic cyclophoria obtained for the six observers are presented graphically in Figures 3, 4 and 5. Individual differences are evident in the extent, direction, and repeatability of the

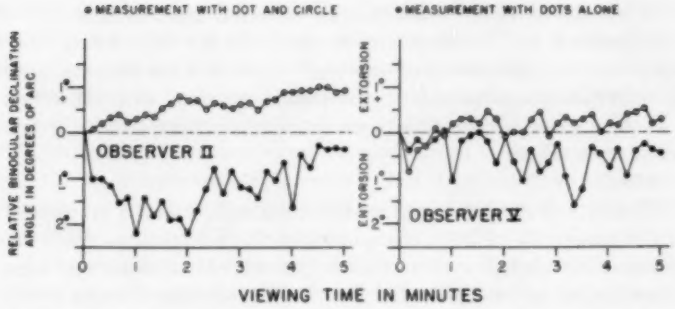
• MEASUREMENT WITH DOT AND CIRCLE
• MEASUREMENT WITH DOTS ALONE
RELATIVE BINOCULAR DECLINATION ANGLE IN DEGREES OF ARC
EXTORSION
OBSERVER II
OBSERVER V
VIEWING TIME IN MINUTES

Fig. 4: Cyclotorsion measures obtained successively with the two observer tasks utilizing an optically projected circle.

measured cyclorotation. The measures as plotted are relative to the indicated zero which approximates the position of the eyes in binocular vision for which a physically vertical line would register no horizontal disparities above and below the fixation point.

The effect of the peripheral circle as part of the measuring configuration on the measurements is indicated by the consistent separation of the data points for each observer with the dots and circle and the dots alone. The data obtained with the dots alone consistently indicate a greater entortion than that obtained with the dot and circle configura-

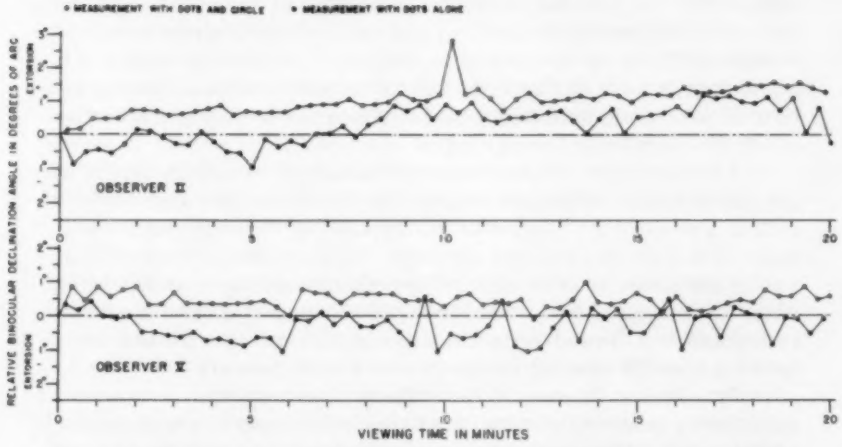

Fig. 5: Cyclotorsion measures for an extended period of time obtained alternately with the two observer tasks.

tion. This difference is consistent in direction both within any five minute sequence and for sequences separated by an intervening day for all six observers, irrespective of the orientation of their astigmatic error. This difference is also present in the sequences taken with Observers II and V irrespective of the circle used or the length of time over which the data were taken.

DISCUSSION

The data plotted as the graphs of Figures 3, 4 and 5 are consistent with the sensitivity of both configurations to cyclotorsion. Each of the six observers evidences a characteristic pattern of response over time to the dissociation of his eyes. Graphs showing similar changes in cyclophoria with time are presented by Allen.[2] The present graphs show in detail the progress of cyclotorsional rotation with dissociation over the initial five and twenty minutes. Allen's curves continue up to one hour.

The interpretation of the moment to moment variability shown in the figures as spasmodic muscle tension would be gratuitous. Similar periodic irregularities are evident in Allen's curves though the time interval of his measurements was thirty rather than ten seconds. It is more probably that the abrupt changes in successive measurements, three or less, are indicative of measurement error or change in basis of judgment on the part of the observer. The present data do not confirm the two minute periodicity or cycling of the cyclotorsion suggested by Allen. This could be because the relaxed state of the extraocular muscles was not attained due to the alternation of the measuring tasks with a light adaptation interval, or because the five minute time interval was not sufficient for the cycling to develop. The fact that cycling was not obtained even with the twenty minute sequences points to the alternation of tasks as the probable deterrent if periodic tensing is truly typical of the relaxed, dissociated eyes.

The magnitude of the evident cyclophoria of these observers is in general agreement with those reported by Allen[2] and Hermans,[3] which include a mean of 24 minutes of arc reported by Hermans and a maximum of 3.2 degrees reported by Allen. It is interesting to note that two of the observers evidence excyclophoria or encyclophoria depending upon the measure chosen. That the type and magnitude of the evident cyclophoria can depend upon the dissociation time as well, is evident in the data of Observer II for the twenty minute interval.

Of primary interest is the difference between the measures of cyclotorsion taken with and without the circle as part of the measuring configuration. Apparently the observer task of adjusting the dots to equidistance one with the other is not equivalent to adjusting the dots to

equidistance with the circle. The rationalé of measurement with the dots, both without and with the encompassing circle, is the same. It is that the vertically displaced dots when adjusted to equidistance, one with the other, or both with the circle, in binocular single vision, will stimulate corresponding retinal points and mark the projection of the vertical stereoscopic horopter. With cyclorotation of the eyes, the inclination of the projected stereoscopic vertical will change relative to the physical vertical by an amount trigonometrically related to the cyclorotation present.[3, 6]

The possibility must be excluded, however, that the difference evident in the data might have resulted from an apparatus factor or some feature of the observer's refraction. The following points are offered for consideration. (1) The physical grid and circle were, in the reference condition, actually and perceptually co-planar and vertical. The zero, or reference measurement, was obtained through stereoscopic adjustment of the dots to coincide with this plane. This is portrayed in the graphs by the single point at zero time for all measurement sequences. (2) The observers were selected to sample two categories of astigmatic error. The meridional orientation of the astigmatic magnification was opposite for the observers whose data are graphed on the left of Figure 3 to that of the observers whose data are graphed on the right of Figure 3.* Thus, if the circle were seen stereoscopically sloped due to oblique meridional astigmatic magnification and the observed difference induced accordingly, the obtained difference between the two tasks should be opposite in sign for the two selected groups of observers. (3) The same difference was evident in the data obtained with each of two circles, the one fixed and physically present, the other movable and optically projected. A constant bias attributable to physical irregularities of the one circle could not be present in the other. Evidently, the lack of equivalence noted is a fact, and consideration must be given to the possible mechanism by which a circle can provide stimulation for, or to inhibit, the cyclorotation of the eyes.

The presence or absence of the circle provided, in addition to the desired difference in observer task, two conditions of stimulation for vertical and lateral fusion. Herein would seem to lie the possibility of an explanation of the difference obtained between the measures of cyclorotation. Pointing of the eyes to bring visual stimulation to the fovea is the consequence of an intricate balance of muscle tensions. The anatomical organization of the extraocular muscles with their planes of action at odd angles to the optical axis is such that all the muscles are involved in every eye movement.[9] If the assumption is

*Due to the recording of the astigmatic error in negative cylinders, Observer II is erroneously categorized in this figure.

made that afferent neural impulses from the retina are necessary to provide the control for precise coordination of the eyes through moment to moment feedback,[9] the additional stimulation to fusion provided by the circle in the measuring configuration becomes a case in point.

In the present work, the fixation of the observer was essentially uncontrolled. The observer was instructed to check his settings, once accomplished, by attending to the central dot. However, no instructions were given against attending to the upper and lower dots while making a setting. Thus, it can be assumed that the process of making an adjustment involved a visual scanning of the configuration as well as the manipulation of the dots. In the initial stages of the adjustment, while the dots were perceptually at markedly different stereoscopic depths, such scanning might involve both elevation and vergence of the eyes. The completion of the adjustment should have eliminated the vergence element of the eye movements except that in the absence of adequate coordinating visual stimulation, musculature adjustments consequent to the act of verging the eyes could substitute for manipulation of the dots.

Pursuing this possibility further, a rather specific role of the circle as a stimulus to fusion can be postulated. With the circle present, innervation to vergence would be inhibited by the shift of the circle to noncorresponding points, and the adjustment of the dots would be made by disparity only. With the circle absent, the innervation to vergence would not be inhibited, and both vergence and torsion would result. Since the action of the superior obliques is to produce entorsion in conjunction with convergence and extorsion in conjunction with elevation of the eyes, the adjustment of the dots would conform to the resultant of these two tendencies. Thus, the evident differences is between an observer's cyclophoria in the primary position and the cyclotorsional shift consequent to elevating and verging the eyes.

The relative variability of the measures taken with and without the circle present indirectly confirms such an explanation. The assumption is tacit to the above explanation that the eyes were under greater cyclotorsional control when the circle was present and hence should have been more stable. The relative stability of the measures obtained with the circle present as compared to those obtained without the circle is consistent with this assumption.

Comment should be made about another possible explanation of the obtained results. The work of Hermans has demonstrated a relationship between the cyclotorsion of the eyes and the degree of convergence. It might be suggested that this relationship in conjunction with the known phenomenon of fixation disparity demonstrated by

Ogle and others could account for the difference in the cyclotorsion measured by the two tasks of the present study. Such an explanation would be consistent with the relative fixational stimulation provided by the presence and absence of the circle, as well as the resultant direction of cyclotorsional shift. The magnitude of the various phenomena, however, are not appropriate. The relationship established by Hermans requires as much as ten degrees of convergence change to produce one degree of change in cyclotorsion. Fixation disparity is limited by the extent of Panum's area in central vision to approximately 15 minutes of arc. Within the limits of single vision, fixational inaccuracies while viewing the fixation dot could not induce, via the Hermans' relation, cyclotorsional changes of the obtained order of magnitude.

It should also be noted that this explanation assumes an action of the extraocular muscles in verging opposite in direction to that of the first explanation. Thus, an application of the vergence and elevation relations established by Hermans in the context of the first mode of explanation would result in a contradictory prediction of the expected direction of the obtained difference.

SUMMARY

Efforts to demonstrate the equivalence of two stereoscopic measures of cyclotorsion resulted in the detection of an unsuspected relationship between the cyclotorsional state and the available visual stimulation to facilitate the lateral and vertical coordination of the eyes. This relationship was evident in the cyclotorsional adjustment of the eyes to the presence or absence of a peripheral circle in the measuring configuration.

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ON THE RELATIONSHIP BETWEEN ACCOMMODATION AND ACCOMMODATIVE CONVERGENCE*

PART I. LINEARITY

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The nasalward rotation of a covered eye in response to an increase in accommodation of the other eye has been called accommodative convergence. In quantitative experiments on this visual function it is necessary to distinguish between 1) the stimulus to accommodation, 2) the accommodative response of the eye, and 3) the resulting response of convergence. The first of these is controlled by the investigator and is an independent variable: the latter two responses by the subject are dependent variables both of which are influenced by observational and random errors. When the *stimulus* to accommodation and the resulting change in convergence are plotted, it is fairly simple to fit the data to a curve (or straight line) by ordinary regression methods. If, however, the accommodative *response* of the eye is plotted on one coordinate and convergence on the other, then the usual regression methods are inappropriate because each of these variables is subject to error and each is dependent upon the stimulus to accommodation.

Until recently the relationship between accommodation (either stimulus or response) and accommodative convergence has been considered to be essentially linear. In 1955, Westheimer[1] showed a decidedly curvilinear relationship between accommodative response and convergence for two young adults over a range of about 4 D. For one of his subjects, however, curvilinearity was not evident three months later.

Martens and Ogle,[2] using a fixation-disparity method to derive the relationship between convergence and stimulus to accommodation over a range of approximately 6 D., found nonlinearity in eight to ten per cent of 250 subjects. Some of their subjects failed to accommodate in response to a change in added lenses. Also, in some cases the fixation disparity increased in response to blurring of the target. It was their impression that subjects with nonlinear responses had more complicated oculomotor problems than usual. The authors were uncertain

*Read before the annual meeting of the American Academy of Optometry, Chicago, December 12, 1959. For publication in the September issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY. This study was supported in part with funds from a grant (No. B-2442) from the National Institute of Neurological Diseases and Blindness, U. S. Public Health Service, Washington, D. C.
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of the stability of the nonlinearity since retesting was not routinely done. For one subject a similar nonlinear relationship was observed four years later.

Alpern et al.[3] reported that when attention is confined to the range over which the accommodative response is linearly related to accommodative stimulus, then each is also linearly related to accommodative convergence. They emphasized that when a large range of accommodative stimuli was used, none of the curves for their four subjects was linear.

The present experiment was designed to study the relationship between accommodation and accommodative convergence in a number of subjects over an extended period with particular attention to the linearity of the regression. What is the proportion of those showing linearity to those with significant departures from linearity? Is the measure of linearity consistent with time?

With these aims in mind, data were collected in the following manner. Measurements were made with a haploscope over a stimulus range of 6.25 D. of accommodation. Measurements were also made with a refractor over a range of 3.50 D. When fitting the data for accommodative response and convergence, an appropriate statistical method (described by Madansky[4]) was used to allow for the fact that both of these variables are dependent and subject to error.

EXPERIMENTAL PROCEDURE

Twelve college students served as subjects for the experiment. Eight of them were untrained persons who had ocular symptoms associated with reading and were receiving orthoptic training to improve positive fusional convergence. The remaining four subjects were students in the School of Optometry; they did not receive orthoptics but each had previous experience as an observer in psychophysical experiments. Two of these optometry students had ocular symptoms associated with reading (M.K. and J.O.).

Experimental trials were scheduled at approximately weekly intervals for about three months; five of the orthoptic subjects returned for study one year later. Each trial lasted about 40 minutes and consisted first of 20 measurements obtained with a refractor (five measurements at each of four accommodative levels) and then 30 measurements with a haploscope (five measurements at each of six accommodative levels). The stimuli to accommodation were presented in the following order: 0.0, 2.5, 1.5, and 3.5 D.; two additional stimuli of 5.0 and 6.25 D. were presented with the haploscope. All measurements were made with the ametropia corrected and with the right eye fixating.

With the refractor the lateral phoria for the zero-diopter accommodative stimulus was determined with a Risley prism and a red Maddox rod (axis horizontal) centered before the left eye; a small point source of light was viewed by the right eye at a distance of 6 M. A 40 cm. fixation distance was used for the other accommodative stimuli: a Risley prism was centered before the left eye and a 6Δ base-down prism before the right; the target, consisting of a black 1 cm. square containing many fine vertical lines on a white background, was centered in the median plane. Lenses of +1.00 D. and − 1.00 D. were added binocularly to produce the accommodative stimuli of 1.5 and 3.5 D., respectively. The procedure was to place an occluder before the left eye and then to uncover the eye briefly so that the subject obtained a brief exposure of the vertical streak (at 6 M.) or of the lower diplopic image of the square (at 40 cm.). The subject judged whether the briefly seen image was to the left or right of the target continuously fixated by the right eye. The power of the Risley prism was changed in steps of 0.5Δ at random and the response at each setting was noted. Between six and ten settings were usually required to establish the limits of the interval of uncertainty. The midpoint of this interval was recorded as the lateral phoria. Five measurements were obtained in this fashion at each accommodative level.

With the haploscope (Figure 1) the right eye was directed straight ahead to view a target which consisted of a photographically reduced test chart in a Badal optometer. Movement of the chart toward the

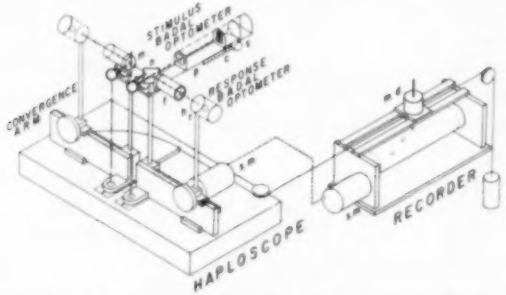

Fig. 1. Haploscope and recorder. Source (s) transilluminates chart (c) which is imaged by lens (p). Right eye sees this image through semi-silvered mirror (n) as well as a reflected image of pinhole (h). Subject adjusts this pinhole (h) and transilluminating source (r) with respect to lens (f) and generates voltage in selsyn motor (s.m.) which is transmitted to second motor (s.m.) causing rotation of recording drum. The image of another pinhole is reflected into left eye by fully silvered mirror (m); convergence is measured by rotation of left haploscope arm which, by means of pulleys and weights, moves marking device (m.d.) along abscissa of graph.

eye produced an increase in accommodative stimulus without a change in the angular magnification of the chart. The accommodative response with respect to the 15 mm. spectacle plane of the right eye was determined by subjective stigmatoscopy; the subject fixated a letter of five minutes overall subtense and adjusted the position of a pinhole on the right haploscope arm until a red spot, imaged in a semi-silvered mirror, appeared to have its smallest diameter. At the same time the subject rotated the left haploscope arm around the center of rotation of the eye until a small green spot, reflected into the eye by a fully silvered mirror, was seen below the letter but vertically aligned with it and the red spot above. The convergence of the left eye and the corresponding accommodative response of the right eye were plotted on x,y coordinates by an automatic recording device.

RESULTS

All data were plotted with accommodative convergence (as measured by adduction of the left eye) on the abscissa and accommodation of the right eye on the ordinate (Figure 2). For the refractor data,

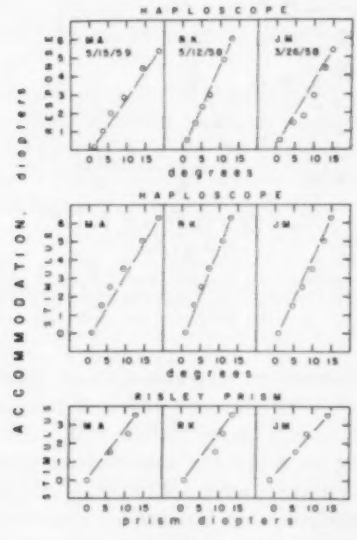

Fig. 2. Relationship between accommodation and accommodative convergence. Each circle represents mean of five data points. Dashed straight line is directed at lowermost and uppermost means. Nonlinearity illustrated by departure of intermediate points from line.

convergence was in prism diopters (read from the Risley prism) and accommodation was in diopters of accommodative stimulus (determined from the testing distance and the added lens power). For the haploscope data, convergence was in degrees (of rotation of the left haploscope arm) and accommodation was plotted both as diopters of accommodative stimulus (read from the Badal optometer carrying the test chart) and as diopters of accommodative response (read from the stigmatoscope on the right haploscope arm).

The linearity of the data was tested by the following statistical method.* For each trial a straight line was drawn between the mean of the lowermost group of five points and the mean of the uppermost group (Figure 3). The number of intermediate points lying below the line

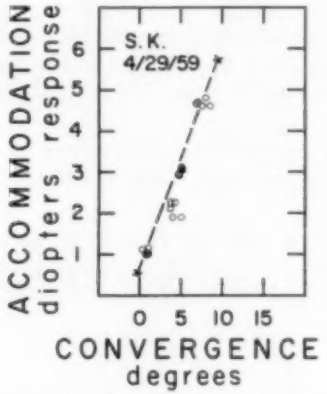

Fig. 3. Illustration of computation of linearity score. Symbol X designates mean of lowermost and uppermost five data points; dashed straight line connects these means. Of the 20 intermediate points, three are above the line, seventeen below. The linearity score in this instance is $3 - 17 = -14$.

was subtracted from the number lying above. Since there were 20 intermediate points obtained with the haploscope, a score of +20 would indicate all intermediate points above the line and −20 all below. For the refractor data there are only ten intermediate points. Shown in Table I is each subject's average score for the indicated number of trials. If, for any subject, the relationship between accommodation and accommodative convergence is linear over the range investigated, then from day to day the mean difference in the number of points above and below the line should not differ greatly from zero (null hypothesis). The

*Suggested by Professor Lincoln Moses, Statistics Department, Stanford University.

TABLE I

Analysis of data testing linearity of relationship between accommodation and accommodative convergence

Subject	Number trials	Haploscope response	Haploscope stimulus	Refractor stimulus
L.D.	12	—10.4*	+ 1.2	— 7.5*
R.K.	10	— 6.6*	+ 7.5*	+ 0.2
J.L.	13	+ 5.9*	+ 8.5*	— 3.5
J.M.	12	—15.7*	—10.9*	— 2.3
M.P.	12	— 5.8*	+ 3.2	— 6.0*
S.N.	11	— 3.7	+11.2*	— 7.0*
D.S.	8	—15.0*	—10.9*	— 6.4*
J.R.	8	— 4.1	+ 7.5*	— 6.5*
M.A.	10	+ 8.5*	+13.1*	— 4.4
J.O.	10	—12.9*	— 6.6*	— 1.4
S.K.	9	—13.3*	— 1.0	+ 3.3
M.K.	9	—12.9*	— 1.9	+ 1.8

Minus scores indicate curves were concave upward; plus, convex upward. Scores significant by t-test at 5% level designated with asterisk. Bottom four subjects did not receive orthoptic treatment.

t-test is appropriate to test the significance of the observed differences since the data from one day's trial to the next can be considered to be independent. For each subject the null hypothesis was tested by the t-test with N −1 degrees of freedom, where N equals the number of trials.

All twelve subjects showed a statistically significant nonlinearity by one or more of the plotting methods (Table I). Ten of them had a nonlinear relationship between accommodative *response* and convergence, the curves being concave upward (minus score) for eight subjects and convex upward (positive score) for two. Without exception, the haploscope curves became less concave or more convex upward when accommodative *stimulus* was plotted on the ordinate. As would be

TABLE II

Mean and minimum r^2 values for N trials of 20 observations each

Subject	Number trials	Haploscope —response— mean	Haploscope —response— minimum	Haploscope —stimulus— mean	Haploscope —stimulus— minimum	Refractor —stimulus— mean	Refractor —stimulus— minimum
L.D.	12	.963	.847	.959	.828	.953	.837
R.K.	10	.972	.937	.967	.938	.980	.936
J.L.	15	.889	.657	.878	.642	.958	.877
J.M.	15	.986	.934	.983	.921	.980	.961
M.P.	15	.948	.902	.943	.891	.954	.855
S.N.	14	.952	.905	.939	.885	.960	.910
D.S.	10	.980	.937	.984	.958	.957	.858
J.R.	13	.900	.850	.886	.831	.904	.756
M.A.	10	.982	.949	.975	.937	.992	.982
J.O.	10	.942	.853	.961	.864	.979	.938
S.K.	9	.962	.921	.963	.912	.973	.948
M.K.	9	.985	.968	.986	.961	.989	.979

expected for a smaller range (3.5 D.) of accommodative stimuli, only five subjects evidence a significant nonlinearity for the refractor data; for each of them the indicated curvature was concave upward.

For illustration, the mean data for three subjects at one trial are plotted in Figure 2. Here nonlinearity is represented by the departure of the intermediate points from the straight line connecting the lowermost and uppermost means.

A straight line was fitted by least squares to the three sets of data obtained at each trial. The coefficient of correlation, r, as well as r^2 were calculated and found not to be materially different when data from four or from six accommodative levels were used (see Figure 4). Table

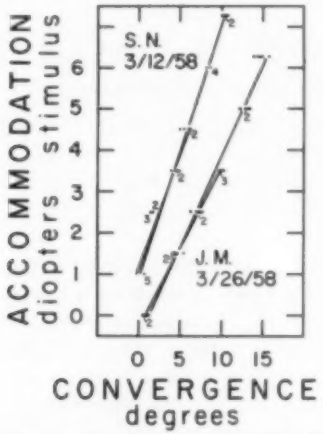

Fig. 4. Examples of the value of r^2 (squared correlation coefficient) computed for six accommodative levels instead of four. For subject S.N. the r^2 values for six and four accommodative levels are, respectively, 0.9771 and 0.9141; for subject J.M. 0.9906 and 0.9996.

II compares r^2 for three methods based on four accommodative levels (0.0, 1.5, 2.5, and 3.5 D.).

DISCUSSION

It is noteworthy that a nonlinear relationship could be made more nearly linear for certain subjects by using convergence units of prism diopters instead of degrees, and by referring accommodation to the principal plane instead of the 15 mm. spectacle plane. However, this same change resulted in a more curvilinear relationship for other subjects. Thus, the observed nonlinearities are not attributable to the use of a particular reference plane or set of units.

Even though the observed nonlinearities are statiscally significant, are they significant practically? Restated, what consequences follow from assuming linearity for those subjects showing statistically significant departures from linearity? The answer depends upon the purpose for which the assumption is to be used. Clearly, the assumption is not justified in predicting a particular relationship beyond the range of accommodative stimuli investigated (extrapolation). It is well known that the relation between accommodation and accommodative convergence becomes markedly curvilinear as the limit of accommodation is approached. If, however, the assumption of linearity is used as a justification for fitting the data to a straight line (interpolation), the results of the present investigation indicate that the observed nonlinearities are not of practical significance and the assumption of linearity is good and valuable. This conclusion is based on the following correlation analysis of the data.

The correlation coefficient, r, is a measure of the closeness of the relationship between two variables. Either an increase in variability or a departure from linearity will reduce the value of r. The high values of r obtained in the present study is notable; nine-tenths of 426 individual r values exceed 0.95. Since even the lowest individual value of r, 0.80 (corresponding to $r^2 = 0.642$ in Table II), might be expected by chance from an uncorrelated population far less than once in one-thousand times, it is clear that all of the individual correlations are highly significant.

The squared coefficient of correlation, r^2, indicates the proportion of the variability in one variable that might be predicted or "explained" from the other variable. Nine-tenths of the individual r^2 values are above 0.90; in these cases only 10 per cent or less of the variability remains unexplained and thus the predictive value of the correlation is very high.

Finally, the question arises as to any systematic change in linearity during the time interval of the experiment. To answer this, computation was made of the rank correlation between trial number and linearity score (see Table I). Of the 36 correlation coefficients (twelve subjects, three experimental conditions each), 30 are not statistically significant, six are significant at the 5 per cent level (about equally divided among the three experimental conditions), and none are significant at the 1 per cent level. It would appear that the linearity score was quite stable with time for the majority of the subjects.

In summary two conclusions seem justified. First, in regard to the frequency of linearity. Significant nonlinearity was found in a consid-

erable proportion of the cases. These appear quite regular in shape suggesting curves that are either concave or convex upward for a given subject and a given experimental method. Concave curves were much more common than convex ones especially for the haploscope response data. Although the curvature is slight, it should be noted that in concave curves the AC/A ratio decreases for greater accommodative stimulus levels, the opposite for convex curves.

Second, in regard to the consequences of assumed linearity. The departures from linearity were consistent but small and showed no distinct trend with time. Therefore the assumption of linearity within the range of accommodation studied and over the time interval involved will have negligible effect on the amount or stability of the AC/A ratio. This point is important for the argument in subsequent papers[5, 6] on the stability and alteration of the AC/A ratio.

The author gratefully acknowledges the statistical advice and assistance of Professors Lincoln Moses, Stanford University Statistics Department, and Frank W. Weymouth, University of California School of Optometry.

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THE PHORO-ACCOMMODOMETER AND THE ACA RATIO*

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Bloomington, Indiana

The phoro-accommodometer[1] is a small haploscope utilizing a vernier optometer and a modified Thorington phoria test arrangement. The ACA‡ ratio is a clinically useful measure of a patient's ability to maintain clear single binocular vision. It has recently come into considerable controversy as to its stability and fundamental nature.[2, 4, 5, 6, 7, 8] Some of this difference of opinion comes from a difference in point of view as to what is the fundamental aspect[5, 6, 8] of the ACA ratio. There are those like the author who have defined the amount of innervation to accommodation and convergence as being the fundamental relationship which is constant while others have held that the manifest *clinical* accommodation and convergence measures are the fundamental relationships and therefore believe that the ACA ratio is not a constant.

It is quite apparent from a consideration of the differences in the accommodative and convergence motor apparatuses, and from the differing chemical and age sensitivities that the manifest relationship between accommodation and convergence cannot be a constant. Furthermore, the variations resulting from subjective testing due to operator errors and patient judgment errors and equipment errors have made it important that statistics[2, 3] and large samples be used for ACA studies, a technique poorly suited for individual patient evaluation and for getting at the truth about the ACA ratio.

The phoro-accommodometer permits the evaluation of the ACA ratio by precise measurements of accommodation and convergence (virtually simultaneously) and an individual's ACA ratio can be studied in detail in a few minutes. Changes induced by fatigue, ill health, drugs, exercise, and age can be precisely evaluated.

More widespread use of precise accommodative and convergence measuring equipment by researchers should remove the cloud of confusion surrounding the concept of the ACA ratio.

*Submitted on May 1, 1960, for publication in the September, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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‡The ACA ratio is the fraction in which the numerator is the amount of convergence change in prism diopters and the denominator is the amount of accommodative change which caused the change in convergence.

Fig. 1

Figure 1 is a photograph of the phoro-accommodometer designed for general clinical use. It is provided with a counterbalanced height adjustment, adjustable forehead and chin rests and has corneal positioning sights. It provides a centering aperture for the patient to assure that his pupil is properly positioned with respect to the critical exit pupil of the vernier optometer.

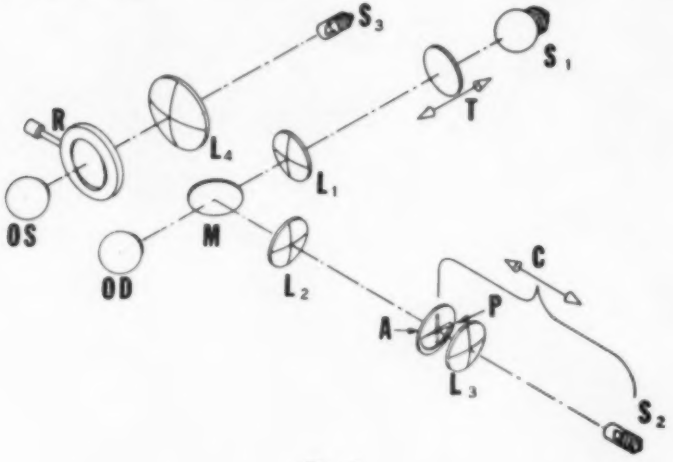

Fig. 2

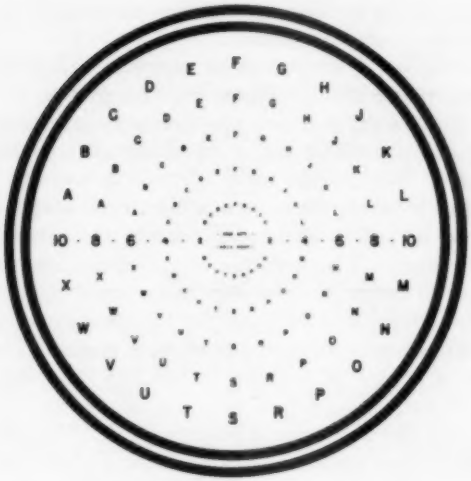

Fig. 3

Figure 2 is a schematic drawing of the optics. The lens and the line filament, S_3, before the left eye constitute a collimator which provides a line imaged at infinity: all rays leaving the lens toward the eye are parallel to one another. The prism is used to change their direction as needed to make the line imaged in the left eye appear on the scale seen by the right eye.

Figure 3 is the pattern (T) seen by the right eye and used to stimulate accommodation. The numbers in the horizontal meridian form a scale and are each separated by 2 prism diopters. The line for the left eye is flashed on for about ¼ second and its position on the scale is noted. The prism value of the position on the scale and the

Fig. 4

amount of prism before the left eye combine to indicate the true convergence of the eyes from parallelism.

Figure 4 is the pattern of the target seen by the right eye from the vernier optometer portion, C, of Figure 2. This pattern appears as two bright vertical lines in the center of the fine letter portion of Figure 3. Ajustment of C forward and backward produces the pattern changes shown in Figure 4.

By adjusting the pattern into vernier alignment while accommodating on the fine letters and by flashing S_3 on momentarily, the following has been accomplished: The stimulus to accommodation may be read from the position of target T. The response in actual diopters of accommodation to this stimulus is indicated by the position of assembly C. Finally, the exact convergence at that moment is given by combining the patient's report of where he saw the flashed line with the amount of prism at R.

The values of the optics are as follows: L_1, L_2, L_3, and L_4 are all simple +10.00 D. biconvex lenses with front to back surface power ratios of about 6 to 1. S_1 is a frosted 7½ watt 110 volt bulb while S_2 and S_3 are each retinoscope streak bulbs arranged with their filaments vertical as shown. M is a plane glass 50% aluminized mirror used as a beam splitter. A is a diaphragm containing a thin vertical slit bisected by a 2Δ prism fragment arranged as shown. (Actually two prisms are preferable, each of 1Δ power placed base left on the upper portion and base right on the lower portion of slit A.

The lenses L_1 and L_2 are placed 10 cm. from the right eye entrance pupil and therefore form Badal optometers. Since S_2 is 10 cm. from L_3 it is imaged by L_1 and L_2 in the plane of the patient's pupil as a single vertical line. When aperture A is placed in the system it becomes a target whose edges are imaged sharply on the retina of the properly accommodated eye. By placing the prism across the slit as shown, no change occurs in the appearance of the slit itself, but the image of S_2 in the plane of the patient's pupil is doubled, and the light from the upper portion of the slit at A goes through one side of the patient's pupil, while the light from the lower portion of the slit at A goes through the other side of the patient's pupil. This duplicates Scheiner's disc setup with the added refinement of a vernier criterion of proper focus (see Figure 4) as compared to a simple target doubling seen with Scheiner's pinhole disc.

The use of the afore-mentioned constants provides a 2 mm. separation of the images of S_2 in the patient's pupil, which is small enough to enter most pupils. To provide less separation for a smaller pupil (with some loss in sensitivity) it is convenient to note that each prism

diopter used at A produces a millimeter shift of the image of S_2 in the plane of the patient's pupil.

Summary: The phoro-accommodometer is an office version of a research haploscope and possesses much potential to perform precise and important experiments on accommodation and convergence and their interrelationships. The knowledge and understanding of the ACA ratio would be greatly advanced if more studies were done with suitable instrumentation similar to the phoro-accommodometer. Such studies would quickly dissolve the conflicts of opinion at least in so far as learning the facts.

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AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 37 September, 1960 No. 9

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Annual Subscription. United States and Canada. $8.00 in Advance: Foreign. $9.00: Single Copies 80c

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Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

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CURRENT FORMS OF KICK-BACKS

When is a kick-back not a kick-back? The answer to this question is to be found in an article by Warren A. Wilson, M.D., in GUILDCRAFT, a monthly magazine described as "the common meeting place of medical refraction and ethical dispensing." [1] Dr. Wilson's article consists of excerpts from a speech to a convention of the California Association of Dispensing Opticians. It was printed earlier in the January and March, 1960, issues of THE DISPENSING OPTICIAN. Its message seemingly has reached many opticians and ophthalmologists.

The second and third paragraphs of Wilson's article supply the answer to the question raised earlier.

> I am sure that the ophthalmologist receives more from the optician than he has a right to expect in ancillary services. When you think of it, probably no ophthalmologist ever started an office without the local opticians seeing that he got all of his equipment

[1] Wilson, Warren A. The relationship between doctors, dispensers and patients. *Guildcraft*, 34 (7): 15-16, 21-25, 1960.

from one source or another; they may help design his office, possibly do all the ordering for him, and then—what is perhaps even more vital—they keep that equipment going for all time. For instance, I just tell my nurse, or write on a slip, "Point light in No. 6." Later it seems to have been taken care of. I know that the opticians do all this work for us and I think it's a wonderful thing.

Then there's the extra help they give us in so many other fields. I'll be scheduled at a scientific meeting or a PTA group and I'll think, "We ought to have some slides," and I call up one of the opticians. Next thing I know, he's down here with a projector. You can count on it.

Seemingly, a kick-back is not a kick-back when it takes the form of architectural services, equipment ordering, supplying and maintenance, slide and projector loans and other "ancillary services." Seemingly, in the minds of some ophthalmologists, no kick-back has been rendered so long as cash does not change hands. Congressmen and other Washingtonians, plagued with fur coats, deep freeze and entertainment scandals must regard such ophthalmologists with a jealous eye indeed. Apparently, they can do with impunity what our national politicians dare not do.

Further along in his paper Wilson relates a most revealing little tale to his audience of opticians. It bears reprinting in full:

That last point brings to mind the point of referrals from an optician to a doctor. I think that any doctor in his right mind, if he had a reference from an optician, would send it back to that individual. Some opticians make a referral and resent the fact that they don't see the patient again. I had a teen-age girl who was exotropic. I subsequently did some surgery on her which took care of that. The reference came from an optician, and when she came to me she was wearing —.50. She had been told to wear her glasses. She had the typical teen-age complex and so I told her that the glasses weren't doing her any good. She had broken these glasses and the optician sent her to me; and later he called me and was very unhappy because I hadn't sent her back. He eventually profited on the case because I had taken the glasses off the girl and changed her personality. So the grandmother said that she thought I was the nicest doctor she had ever heard of; and she was one of those who wanted the full treatment. She wanted the bifocals clear, she wanted them tinted, she wanted everything twice. "I've got to have four pairs of reading glasses around the house, and I've got by bridge glasses besides." That was a good order when the optician finally got it some months later. So sometimes you may think a doctor is pulling something shady when he isn't at all. He usually has some real reason for it.

Several points of basic philosophy are illustrated in this anecdote. It will be noted that the girl was wearing lenses for myopia of low degree. However, since she had a "typical teen-age complex" (psychologists would be fascinated to learn what that is), she was told that "the glasses weren't doing her any good." Note that she was not told that she might get along without the spectacles if she wished. Rather, because she objected to glasses, she was told that they "weren't doing her any good." We wonder if patients who object to using a specific medicine are told by their physicians that "it won't do them any good." This appears to be a new mode of practice designed to "change personality."

Perhaps the most revealing aspect of the anecdote is the fact that the optician was so unhappy at not having the patient referred back to

him that he called the ophthalmologist. Does this mean that the patient who visits an ophthalmologist and who does not need new spectacles is so rare as to merit concern? More important, is the ophthalmologist so puny that he must bow down and apologize to a lay businessman for not prescribing spectacles?

There is still another basic consideration. In the past it was claimed by those who would detract from optometry that there would be a tendency to overprescribe if the refractionist also dispensed spectacles. On the other hand, these critics stated that the ophthalmologist was not similarly tempted because he did not fill his own prescriptions. In the minds of those who advanced such an argument, the optometrist who might gain would be tempted to oversell spectacles, but the ophthalmologist pressured by the optician and indebted to him for "ancillary services" is not tempted. Here the line of distinction seems to be fine indeed.

Although not directly on the subject, we might note that it has always seemed to us that if this argument against optometric dispensing were valid, a further extension would be equally valid. If the optometrist who dispensed spectacles might be tempted to overprescribe, what of the ophthalmologist when prescribing surgery? If financial consideration could make an optometrist overprescribe materials, could not the much greater stakes make an ophthalmologist overprescribe surgery? Might not the same reasoning be extended to suggest that the diagnostician and surgeon never be one and the same person?

This argument should perhaps be framed in its more hopeful and positive form. It might be asked this way: If an ophthalmologist is sufficiently honest (and most are) to not overprescribe surgery and to not be tempted by the relatively great reward for surgery, is it not conceivable that the optometrist (whose code of ethics and oath to the public welfare is as rigid as that of medicine itself) might also not be tempted to sell an unnecessary pair of spectacles? We have often wanted to ask this question, but Wilson's article makes its asking unnecessary.

This article illustrates an important point in the realm of interprofessional relations. We are sure that most ophthalmologists will be as shocked by its implications as we are. We are sure that many fine ophthalmologists do not accept kick-backs in the form of favors and do not find themselves beholden to lay businessmen for referrals. We are sure that many ophthalmologists are aware that honesty, morals and ethics are attributes of individuals and not the sole property of any one profession.

However, such fine ophthalmologists might be a little more sym-

pathetic to the aspirations of professional optometry. Such ophthalmologists might help professional optometry to fight the commercialists in optometry so that the public may benefit. Optometrists do not condemn all ophthalmologists for the practices of ophthalmologist-optician combines such as that described in this article. Why then should all optometrists be tarred by the brush used on the most offensive commercial optometrists? And when they are, why do the ophthalmologists who know better remain silent?

There's nothing like a scandal in a family to make a man a little more human and understanding of the frailties of others. If it leads to a little humility and understanding of the common problems of all sincere practitioners in both eye professions, the Wilson article will have been of great value. We recommend its reading to all optometrists and ophthalmologists. After doing so, it would seem that the sincerely dedicated men of both professions had best get together and begin talking about how the two groups can end their cold war for their own and the public's best interest.

The existence of a cold war only forces each participant to cover up or boastfully deny his own weaknesses rather than correcting them. Ophthalmology cannot clean its own house any more than optometry can so long as each must fight the other. Each profession can only rationalize its shortcomings, protect its shoddier practitioners and present a solid front. The public, however, deserves (and will fight to get) something better. Perhaps the time for an interprofessional summit meeting is getting closer than we think. If it is delayed too long and the abuses in each profession continue, the public may well decide to solve the problem to the liking of neither profession.

MONROE J. HIRSCH

SPECIAL REPORT

A SIGNIFICANT COURT DECISION

It is probably natural for those of us in the eye care field to view our own portions of this health work from within the professional limitations of our particular sphere of activity. As optometrists we view the work of the ophthalmologist and dispensing optician as being separate and quite apart from the major theme of an optometric practice. We suspect that this is also true of those who practice ophthalmology and those who engage in dispensing. However, from the standpoint of

the public at large, and for that matter from that of our own patients as well, there is a strong tendency for them to view all persons in this field as part of a large group doing something important and of value, but not too pleasant to contemplate.

We who play an active part in this activity have no difficulty in setting up the partitions for each of the groups in the field. Actually few others do this, as is shown by the following District Court decision just released in Minnesota.

This decision is worth reading as it shows the thinking of an outside observer and indicates how his mind reacts to our problems and how he crosses our professional dividing lines as though these were of little importance, which in some measure is true. To him the health of the public is paramount. As all optometrists will benefit by reading this recent decision, it is presented here in full. We believe that it emphasizes the need for constructive and cooperative teamwork on the part of all members of the eye care professions.

CAREL C. KOCH

STATE OF MINNESOTA
COUNTY OF WINONA

DISTRICT COURT
THIRD JUDICIAL DISTRICT

STATE OF MINNESOTA,

Plaintiff,

vs.

BENJAMIN D. RITHOLZ, N. I. RITHOLZ, S. J. RITHOLZ, FANNIE RITHOLZ, SYLVIA RITHOLZ, SOPHIE RITHOLZ, JACOB BENDO, ANNA BENDO, and KING OPTICAL CO., a partnership, and PAUL McJAMES, manager of said partnership,

Defendants.

ORDER

The above entitled action brought by the Attorney General of the State of Minnesota at the instance of the State Board of Optometry, pursuant to Chapter 148.52-148.62, of Minnesota Statutes, was tried by the Court, without a jury, at Winona, on May 10th and 11th, 1960. Mr. Richard W. Johnson of Neville, Johnson and Thompson, Minneapolis, Special Assistant Attorney General, appeared for the state, and the answering defendants were represented by Messrs. Milton H. Altman and James Hart of Lipschultz, Altman, Geraghty and Mullaley, of St. Paul, and Mr. H. M. Lamberton, Jr., and Mr. S. D. J. Bruski of Winona.

The case was finally submitted by the filing of the last brief on July 27, 1960.

At the commencement of the trial the respective attorneys for the parties stipulated:

> That the exhibits attached to plaintiff's complaint and therein labeled with the letters A through and including U, and exhibits which have been labeled BB, CC and DD, and defendant's exhibits labeled 1 through and including 14 are advertisements of the defendant partnership, and appeared in The Winona Daily News on the date indicated on each exhibit.

and also,

> That plaintiff's exhibit AA is a certified copy of the trade name certificate of the defendant partnership now on file and of record in the office of the Clerk of District Court, and that the original was executed by Benjamin D. Ritholz, one of the defendants herein.

It was also stipulated that paragraph V of defendants' answer be amended to read as follows:

> That if Minnesota Statutes, Section 148.7, subdivision 3, does prohibit the advertising of prices of glasses by the defendants herein then said statute as applied to the facts in this case is in violation of the Fourteenth Amendment to the Constitution of the United States, and Article I, subsections 2, 3 and 7 of the Constitution of the State of Minnesota, as abridging the defendants' right to freedom of speech and depriving the defendants of their property in that it unlawfully interferes with their right to conduct a private business and violates their right to freely advertise and sell their property.

During the course of the trial Mr. Johnson stated:

> Paul McJames, named as a defendant in this lawsuit, is, in so far as the state is concerned, no longer a defendant. We do not wish to adopt the position that he is a defendant.

The Court having heard the evidence and duly considered the same together with all the records and files herein and having studied the briefs of counsel, now makes its findings of fact and conclusions of law as follows:

FACTS

1. That the defendants, Benjamin D. Ritholz, 20 East Delaware Place, Chicago, Illinois; M. I. Ritholz, 3300 Lake Shore Drive, Chicago, Illinois; S. J. Ritholz, 3800 Lake Shore Drive, Chicago, Illinois; Fannie Ritholz, 3300 Lake Shore Drive, Chicago, Illinois; Sylvia Ritholz, 3800 Lake Shore Drive, Chicago, Illinois; Sophie Ritholz, 3800 Lake Shore Drive, Chicago, Illinois; Jacob Bendo, 5630 North Kenmore Avenue, Chicago, Illinois; Anna Bendo, 5630 North Kenmore Avenue, Chicago, Illinois, are partners conducting and transacting a business under the name and style of King Optical Co. and that each of the defendants is a non-resident of the State of Minnesota.

2. That at all times in this matter referred to the defendants were and are now dispensing opticians who manufacture and sell eye glasses in accordance with prescriptions from duly licensed physicians and sur-

geons or optometrists, which prescriptions are supplied by defendants' customers; that the sale and dispensing of said eye glasses is carried on at an established place of business in the Morgan Block, 68 West Third Street, in the City of Winona, Minnesota, under the supervision, direction and authority of Emerit O. Thompson, O.D., a duly licensed optometrist, under the laws of the State of Minnesota, who is in charge of and in personal attendance at said place of business; that the defendants solicit patronage by the use of advertisements which set forth the price at which glasses will be supplied to customers; that said Dr. Thompson, as an employee of the defendants, refracts the eyes of persons coming to said place of business, and the defendants collect and keep all fees charged patients therefor; that said partners control the hours of the optometrist and other employees' employment, and furnish and supply the necessary office rooms and make available for the use of the optometrist such equipment and supplies as are necessary for testing and measuring the powers of vision of the human eye and rendering other optometrical services.

3. That the defendants, under the name and style of King Optical Co., solicit patronage for said business by advertisements and that such advertisements are "price advertisements"; and that copies of such advertisements bearing the date of their respective appearances in The Winona Daily News, a newspaper published in said City of Winona, are attached to and a part of the complaint herein.

4. That after the service of process upon the defendants other and additional of said "price advertisements" were published in said newspaper at the instance of the defendants and representative copies thereof are defendants' said exhibits 1 through 14.

5. That there is no allegation in the pleadings that any of the statements contained in said advertisements are false, misleading, fraudulent, deceiving or for the purpose of causing misunderstanding, and there is no denial that the defendants supply glasses at the advertised price.

6. That the plaintiff has no adequate remedy at law.

CONCLUSIONS OF LAW

That the plaintiff is entitled to judgment restraining the defendant partnership and each of the individual partners of said partnership from soliciting business for their said company by advertisements containing price advertising.

Let judgment be entered accordingly after a stay of thirty days from the date hereof.

Dated at Winona this 24th day of August, 1960.

LEO F. MURPHY
District Judge

MEMORANDUM

The statutes involved, Chapter 148.52-148.62, pertain to the services of ophthalmologists, optometrists and opticians.

> An ophthalmologist is a duly licensed physician who specializes in the care of the eyes. An optometrist examines eyes for refractive error, recognizes but does not treat diseases of the eye and fills prescriptions for eye glasses. The optician is an artisan qualified to grind lenses, fill prescriptions and fit frames. (Williamson v. Lee Optical of Oklahoma, 348 U.S. 483 at 486.)

There are no license requirements for opticians in the State of Minnesota.

The defendants are engaged in the optical business with principal place of business at Chicago, Illinois, and they sell eye glasses and optical accessories at their Winona office where sales of eye glasses are made only on prescription of licensed physicians and licensed optometrists. Paul McJames, an employee at defendants' Winona office, described his work or procedures as an optician after receipt of the prescription from the customers as follows:

> I help the customers select the style and frame regarding cosmetic affect and sizing that they might wish to have. Upon selection of a frame of their choice I take the pupillary distance measurement, the bridge measurement, lens size measurement, the temple or bow measurement, copy of the prescription, and from the copy of the prescription—from the doctor's prescription on to the number of our Rx forms, have the customer sign the order and then the order is sent in to the Chicago shop to be filled.

Donald B. Carpenter, shop foreman of the finishing department of the King Optical Company in Chicago, testified as to the procedure there as follows:

> We receive the Rx, we fill it with surfaced or finished lenses—fit the lenses to the frames selected by the customers—all of this work is done on prescription. We mail it back to the branch office.

No employee of the Winona office is authorized to nor does he draft, compose, submit, control, make up advertising or advertise prices or set prices of eye glasses but all such and related matters are prepared and handled by defendants in their Chicago office.

Defendants have many contentions, including, that the statutes have no application to them; that the statutes, if applied to the facts in this case, are in violation of the United States and Minnesota Constitutions; that the plaintiff is not entitled to the relief sought.

Why should legislation against "price advertising" as to the price of eye glasses be held valid as to the optometrist and not as to the optician?

> The result of forbidding the professional practitioner to resort to such advertising and permitting the optician to indulge in the harmful practice does not eradicate the evil. The whole field must be covered if protection is to be afforded the public.
>
> (City of Springfield v. Hurst, 56 N.W.2d 185 at 188, and quoted in Bedno v. Fast (Wis.), 95 N.W.2d 396 at 400.)

On an appeal in an action to enjoin the Minnesota State Board of

Optometry from proceeding with the hearing of charges against a licensed optometrist, the gist of which charges were that he accepted employment as an optometrist at a stated salary with Goodman Brothers Jewelry, an entity incapable of being licensed as an optometrist, the court after affirming a judgment for the plaintiff concluded its opinion as follows:

> If the Goodman Brothers Jewelry Company violates any provision of the optometry statute or the lawful rules of the defendant board *it may proceed against the company.*
>
> (Williams v. Mack, 202 Minn. 402 at 410.)

and in said opinion (at 406) also stated:

> The employment being lawful under the optometry law as it now stands, it seems to us that it is contrary to the letter and spirit of the law to make the employee responsible for the employer's violation of the law and to impute the knowledge of such violations to the employee. *If the employer violates the optometry act in any manner he may be enjoined or prosecuted.*

A statute even though it may operate to prohibit advertising in particular instances in which there is no deception or misstatement does not amount to such arbitrary interference with liberty and property as to violate the requirements of due process of the law.

> The Legislature was entitled to consider the general affects of the practices which it described, and if these effects were injurious in facilitating unwarranted and misleading claims, to counteract them by a general rule even though in particular instances there might be no actual deception or misstatement.
>
> (Semler v. Oregon State Board, 294 U.S. 608 at 613.)

It is admitted that Lee v. Williamson, 348 U.S. 483, is determinative of the federal issue. At page 490 we find:

> An eye glass frame considered in isolation, is only a piece of merchandise. But an eye glass frame is not used in isolation as Judge Murrah said in dissent below; it is used with lenses, and lenses, pertaining as they do to the human eye, enter the field of health. Therefor, the Legislature might conclude that to regulate one effectively it would have to regulate the other—we see no constitutional reason why a state may not treat all who deal with the human eye as members of a profession who should use no merchandising method of obtaining customers.
>
> (Williamson v. Lee Optical of Oklahoma, 348 U.S. 483 at 490.)

In Williams v. Mack, 202 Minn. 402 at 404, the court stated:

> By whatever name called, the work of an optometrist is sufficiently related to or connected with public health—eye sight—to come within the domain of the police power of the state.

and at page 407:

> To be sure, our optometry statutes, with the restrictions against advertising prices and sharing fees and other regulations, give rise to the suspicion that they were sponsored by the optometrists for their own pecuniary benefit instead of being prompted by the legislators' pressure of the need of protecting the public. But, that notwithstanding, it is the court's duty to construe them as primarily intended to safeguard people's eyesight.

State ex rel. Cobbing v. Jansen, 205 Minn. 410, 286 N.W. 305.
State v. Goodman, 206 Minn. 203, 288 N.W. 157.
Reyburn v. Minnesota State Board, 247 Minn. 520, 78 N.W.2d 351.
State of Minnesota v. Ritholz, 100 N.W.2d 722.
Abelson's, Inc., v. New Jersey State Board, 22 A.L.R.2d 929, and annotations 939-955.

In their brief defendants make broad claim that plaintiff is not en-

titled to the relief which it seeks, but do not refer to or cite cases relating to the question whether or not criminal statutes may be enforced by injunction, which question, however, is within said assertion.

A succession of "price advertisements" has been placed in the newspaper amounting to a business policy which defendants would undoubtedly continue if they were not enjoined. The defendants are non-residents; misdemeanors are not extraditable offenses; the defendants are not charged with an isolated offense but with numerous violations of a misdemeanor statute which penalizes breach of law enacted to protect the public health and under the principles enunciated in State v. Red Owl Stores, Inc., 253 Minn. 236, injunctive relief appears to be the proper remedy to prevent them from unlawfully engaging in those acts which the statutes seek to prevent for the protection of the public.

MURPHY, J.

Filed
District Court
Winona, Minnesota
August 24, 1960
Joseph C. Page, Clerk

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

SAN FRANCISCO MEETING OF THE ACADEMY

The 1960 annual meeting of the American Academy of Optometry will be held at the Sheraton-Palace Hotel, San Francisco, December 10, 11, 12 and 13. Academy members from all over the world will meet in this cosmopolitan city for the year's most educational meeting for optometrists, educators and scientists working in the field of vision. Here they will take part in a program dealing with the art and science of visual care and its related basic fields.

Not only are Academy members and their families and guests invited to this meeting but the membership of the California Optometric Association have been invited to come and register and take full part in the four day program consisting of the general papers sessions and the special Section meetings dealing with Contact Lenses and Subnormal Vision Aids; Public Health and Occupational Vision; Orthoptics; Pathology, and Refractive Problems and Aniseikonia.

Registration will start at 8:00 A. M. Saturday, December 10th.

The opening sessions will begin at 10:00 A. M. and the program will continue until 5:00 P. M. December 13th. The annual formal Round Table Dinner will be held Monday night, December 12th, following the usual cocktail hour. A detailed program will appear in our October issue.

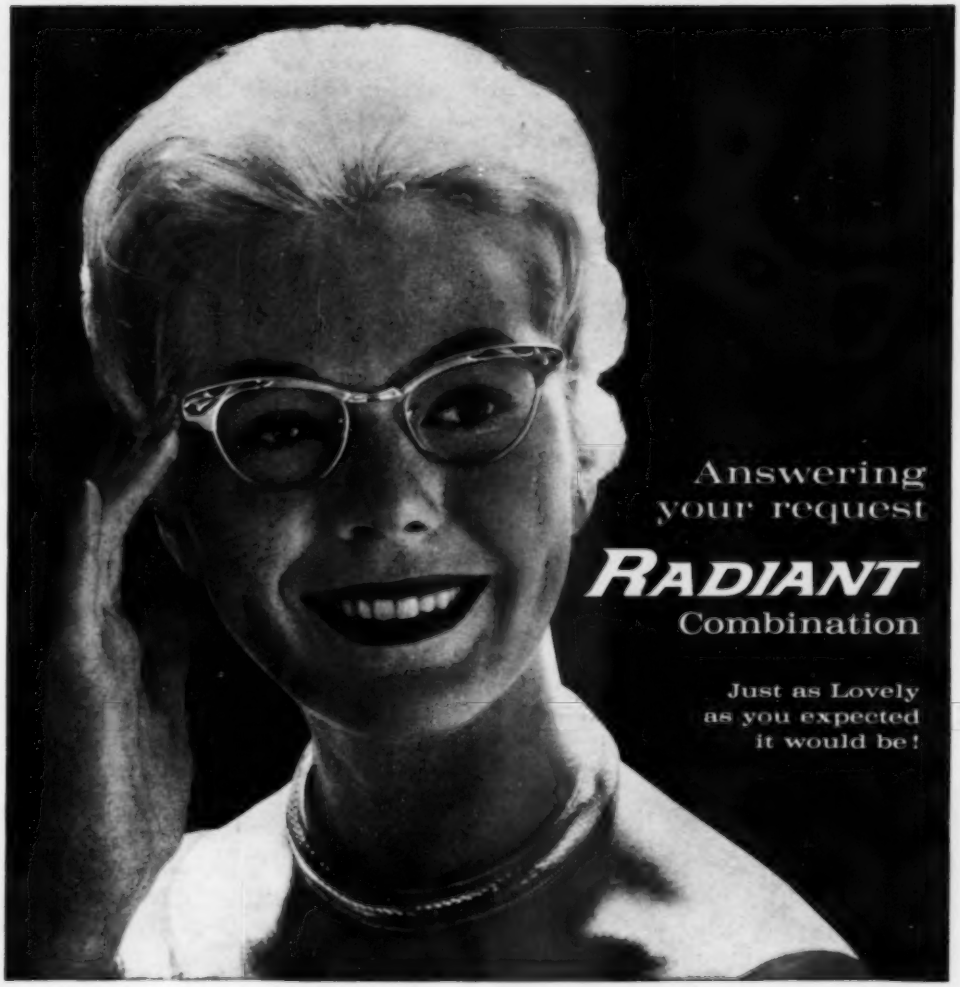
Prior to the meeting and at the same place—the Sheraton-Palace in San Francisco—December 7th, 8th and 9th the Academy Post-Graduate Courses will be given. There are 85 of these courses. Courses are open to any optometrist and all are invited to enroll. These Academy courses are given each year before the convention and most are filled to capacity. These courses were reviewed in the August 1960 issue of this publication. A booklet describing each course and its cost will be sent upon request.

Members of both the Academy and the California Optometric Association will find the following items of interest in planning their trip.

Hotel Reservations. The time to make these is now. Write to Room Reservations, Sheraton-Palace Hotel, San Francisco. Rooms are assigned on a first come first served basis so, to have a wide choice, make your request at once.

Travel Reservations. In December westbound travel by either plane or rail is heavy. Many families spend the Christmas Season on the west coast, so make your travel reservations no later than October 10.

Hawaiian Post Convention Tour. Following the close of the meeting a group of members and their families are flying to Hawaii for a fourteen day vacation. The time to join this group is now. Write to Mr. Martin J. Kupper. Sedard World Travel Service, Inc., 137 South Seventh Street, Minneapolis 2, Minnesota. Full particulars for this fine vacation will be sent you at once.



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Epsilon	B.I.	1440	13.25	7.50
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Zeta	Comb.	1743	13.25	7.50
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